



FIELD EVALUATION OF THE B RATION IN A HOT WEATHER ENVIRONMENT

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) The B Ration and the MRE were evaluated for five days during a training exercise at Eglin Air Force Base, Florida, to determine their acceptance and nutritional adequacy in a hot-weather environment. The effects of beverage flavor and beverage variety as well as meal scheduling on consumption were also investigated. The B Ration was consumed for breakfast and dinner and the Meal, Ready-to-Eat was consumed for lunch. The acceptability of each food and beverage item was rated on a 9-point hedonic scale. A detailed final questionnaire was completed by subjects to determine overall opinions of the rations. Consumption of the B Ration was measured by comparing an estimate of each subject's meal before he began eating to an estimate of each subject's plate waste. Consumption of the MRE was estimated by subjects. The results of the field study indicate that airmen's nutrient and caloric					
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intake of the B Ration/MRE did not meet military nutritional standards. The test site allowed access to nonration foods; this probably contributed to reduced intake of the B Ration/MRE. Inadequate energy intake resulted in insufficient consumption of the majority of macronutrients, vitamins and minerals. Of particular concern was the low calcium intake. Flavorants were added to the nonfat reconstituted powdered milk to enhance milk consumption; however, there were no differences in consumption of the flavored versus plain milk. There was some evidence that beverage variety enhanced beverage consumption. Meal scheduling did not affect intake in the present study. The B Ration was well-liked with the exception of certain dairy products and some of the breakfast foods. The MRE V was rated as less acceptable in the present study than in past studies. However, the newly (1988) developed version of the MRE (VIII) has incorporated many of the changes suggested by subjects in the present study. These changes should enhance acceptance and consumption of the MRE in the future.

(unclassified)

PREFACE

The authors would like to express their thanks to Ms. Shirley Townsend for locating the test site and coordinating the test with Detachment 2 of the Air Force Engineering and Services Center (AFESC) at Eglin Air Force Base, Florida. Sincere thanks are also extended to SMSGT Heyge for coordinating the dining facility staff and functions at Eglin Air Force Base. Special thanks go to Larry Leshar for statistical work, Doris Sherman for work on the nutrient data base, and Irene Abrams for preparing test materials and making preliminary test arrangements with Eglin AFB. Technical work by Joan Kalick, Kathy Rock, Donald Ross, Laurie S. Lester, Barbara Bell, Diane Wisnieski, Larry Leshar and Charles Greene is also greatly appreciated.



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INTRODUCTION

The consumption of operational rations in the field in a temperate environment is less than adequate (1, 2, 3). Although the acceptance and nutritional adequacy of the B Ration in an extremely hot environment has not been fully evaluated, one would predict that consumption may not be sufficient to meet the Military Recommended Dietary Allowances (MRDA). The B Ration consists of nonperishable subsistence items (e.g., canned or dehydrated foods) and is used by the Armed Services when hot meals can be served in field dining facilities, but when perishable foods are not yet available or cannot be stored. The primary purpose of the field study presented here was to evaluate the nutritional adequacy and acceptance of the B Ration in an extremely hot environment. Another purpose of the field study was to determine the effect of several factors which, in a number of laboratory studies, have been shown to enhance intake. Specifically, the effects of beverage flavor, beverage variety, and scheduled versus nonscheduled mealtimes were all addressed.

Studying the consumption of the B Ration, specifically beverage consumption, in a hot environment is particularly important given that in this type of climate, risk of hypohydration is high. The absence of refrigeration makes it critical that beverages be provided that are palatable when served at ambient temperatures, in order to encourage fluid consumption.

The effect of flavor on drinking behavior in animals and humans is striking (4, 5, 6). Sweetened water can stimulate

drinking in animals that have no hydrational deficit (7, 8, 9), and bitter-flavored water can cause animals to become hypohydrated and even die (10, 11, 12). Although the effect of flavor on fluid consumption has been studied less in humans than in animals, such an effect has been demonstrated. Sohar, Kaly and Adar (13) demonstrated that flavoring water could prevent voluntary dehydration in men during a desert march. Similarly, an Army field test has shown that flavoring can enhance consumption of water in the field (14). In a laboratory study in which a desert environment was simulated, it was shown that both beverage flavor and beverage temperature can affect fluid consumption in men (15).

The effect of serving temperature on the acceptability of several foods and beverages has been investigated in laboratory studies (16, 17). In one study, the effects of serving temperature and flavoring on milk acceptability were investigated (17). Chocolate, strawberry and plain nonfat dry milk were taste-tested at four temperatures. The results indicate that the acceptability of nonfat dry milk increases significantly when flavorants are added; this increase in acceptability holds for a wide range of temperatures.

In addition to the effects of flavor and temperature on beverage consumption, the effects of beverage variety on drinking behavior have also been studied in animals and humans. It has been shown that offering a variety of fluids to rats significantly enhances intake (18). This effect has also been demonstrated in humans in a taste testing situation (18).

Furthermore, it has been shown that beverage variety enhances consumption of B Ration-type beverages and foods in a meal setting (19).

Another factor which may affect food and beverage consumption is meal scheduling. External cues such as the time of day, and the sight, taste, smell and availability of food have been shown to affect eating behavior (20, 21, 22). Humans may eat more when scheduled to eat at a specific time and at a specified location than if they choose to eat whenever and wherever they wish (23).

The field study reported here addressed the question of whether beverage flavor and variety or meal scheduling can enhance consumption of B Ration foods and beverages in an extremely hot environment. Average intake of B Ration foods and beverages was measured to determine whether caloric and nutrient intake was sufficient in meeting the Military Recommended Dietary Allowances (MRDA). Food and beverage acceptability was also measured as was soldiers' satisfaction with factors such as variety and portion size. Additional comments and suggestions were elicited to further evaluate the B Ration in an extreme environment.

METHOD

Subjects

Subjects were 79 airmen (75 men and 4 women) who were participating in a training exercise at Eglin Air Force Base, Florida. Their home base was Mt. Home, Idaho. During the

training exercise at Eglin AFB, most of the men and women worked outside, building or maintaining airstrips. This required moderate to heavy daily physical activity.

Only men were included in the data analysis since so few data points were available for women. Male subjects were an average (\pm standard error) of 23.4 years of age (\pm 4.6 months), 70.3 (\pm 0.32) inches tall (179 cm) and weighed an average of 169.6 (\pm 2.4) pounds (77 kg). Subjects had been in the Air Force an average of 2.9 years (\pm 3.5 months).

Procedure

Prior to the study, all subjects were briefed about its purpose. Subjects were told that the B Ration and the Meal, Ready-to-Eat (MRE V) were going to be evaluated for five days during their training exercise. Although other foods were easily accessible, they were asked to limit their diet to the rations and to drink only water and drinks provided at mealtimes during the evaluation period. At the briefing, subjects were divided into eight groups. One representative from the U.S. Army Natick Research, Development and Engineering Center (Natick) was assigned to each group to monitor food and beverage intake during the study. These group leaders explained the study in detail to their respective groups at the briefing. The schedule of the study and the questionnaires that each subject would need to complete were explained. Subjects filled out Background Information and Volunteer Agreement Forms (see Appendices A and B) at that time.

The study was conducted at the dining facility at Eglin Air Force Base. Eglin was chosen by the Air Force as the test site because the Florida weather would be extremely hot in August when the study was to be conducted. Although this location satisfied the requirement for an extreme climate, it should be noted that the field dining conditions at this site were not comparable to those in a battlefield scenario because of the high availability of nonration foods.

The study was conducted for five consecutive days. Three meals per day were evaluated on the first four days; on the last day only breakfast was evaluated. Airmen participating in the evaluation reported to the dining facility 30 minutes prior to the regularly scheduled breakfast and dinner times to minimize interference with those who were not participating in the study. Subjects ate at the same tables every day so that the Natick data collectors could monitor intake for the same group of subjects at each meal. At each breakfast and dinner meal, subjects filled out forms to rate the acceptability of the B Ration.

For lunch, subjects were randomly divided into two groups to determine if meal scheduling affects ration and water intake. Half of the subjects were assigned to the "scheduled group"; this group was required to report to the field dining facility at a designated time to eat their MRE. The other subjects were assigned to the "nonscheduled group"; they could eat their MRE whenever and wherever they wished. Only cold water was available in the dining facility so that water availability would be similar in the two groups. The nonscheduled group could obtain

water from water fountains, which were distributed in a number of locations around the base. All subjects completed consumption and acceptability forms during lunch. These forms were distributed at breakfast and collected at dinner each day.

All B Ration foods and beverages were prepared by experienced cooks and cook trainees according to standard preparation and serving procedures. All ingredients used were recorded by a Natick technician in order to determine if cooks strictly adhered to B Ration recipes. Any deviations from the recipes and cooking procedures were documented so that the nutrient data base could be adjusted to reflect these changes.

Although the majority of items served during the evaluation were B Ration foods, several T Ration items were served as well. The T Ration is similar to the B Ration in that it does not require refrigeration. The T Ration is packaged in a metal container (Tray Pack). Preparation requires only that the Tray Pack be heated; the food is then ready to be served.

At each breakfast and dinner meal, prior to serving the food to the airmen, the cooks prepared 10 food trays to simulate the actual serving of meals on the serving line. Data collectors weighed each food item on the 10 trays to determine the variability in actual serving sizes of B Ration portions. Six "standard trays" were then made up; each tray contained an average-sized portion of each menu item. The trays were then strategically placed on the dining tables to be used by data collectors during the meal. The data collectors compared each

subject's tray to the standard tray to estimate the portion size of each menu item before the subject began eating.

Plate waste was also estimated at breakfast and dinner. The data collectors estimated portions of all foods and beverages after the meal, again, by comparing each subject's tray to the standard tray (i.e., plate waste estimation). After the breakfast and dinner meals, actual plate waste was measured for 25% of the trays. All measurements were made on electronic scales (accuracy $\pm 1g$). Actual plate waste was measured to validate data collectors' estimations.

The breakfast and dinner menus served on the five testing days can be found in Appendix C. In order to investigate the effect of milk flavorants on the acceptance and intake of nonfat dry milk, different flavors were served each day. On some of the testing days, chocolate and strawberry flavorants (Nestle's) were added to the nonfat dry milk that was served at breakfast; either plain, chocolate or strawberry milk was served on three of the days, and all three types of milk were served on two of the days. The flavor(s) served on a given day were randomly assigned.

At the dinner meal, the effect of beverage variety on intake was investigated. Either grape, lemonade or cherry-flavored drink was served at each evening meal, and on one day, all three flavors were served. Again, the flavor(s) served on a given day were randomly assigned. Beverage temperature was measured at each meal. These measurements were recorded because of the known effects of beverage temperature on intake (15) and acceptability (16) in humans.

A nutrient data base was set up for the B Ration by compiling a list of nutrients for all ingredients in recipes served during the five breakfasts and four dinners during the study. Retention/loss factors were included in the data base to compensate for any losses of nutrients (predominantly vitamins) that occur during cooking. Other factors such as evaporation of moisture and the addition of fat during cooking were also accounted for in the data base to allow for a more accurate measure of nutrient intake. Nutrient data for the T Ration was provided by the Food Engineering Directorate at Natick and was also included in the data base. Nutrient and caloric intake for breakfast and dinner were calculated from information in this data base and B Ration/T Ration consumption data. An MRE nutrient data base (which was comprised of nutrient information for MRE V provided by the Food Engineering Directorate) and MRE consumption data were used to compute nutrient and caloric intake of the MRE.

Data Collection

B Ration and MRE acceptability forms (Appendices D and E) were used to collect acceptability data. A 9-point hedonic scale was used to rate the acceptability of each food and beverage item, where 1 corresponds to "dislike extremely," 5 corresponds to "neither like nor dislike," and 9 corresponds to "like extremely" (24).

B Ration and MRE intake forms (Appendices F and E) were used to collect intake data for each 24-hour period. Intake of the B

Ration was measured by data collectors, who estimated portions of each food and beverage served to each subject before and after the breakfast and dinner meals. Pre- and postmeal estimations were recorded on the B Ration intake form. Intake at lunch was recorded on the MRE intake form by subjects who estimated the portion of each item they consumed, i.e., 1 portion, 1/2, 1/4, 0, etc. This form was also used to record any food or drinks consumed between meals.

Prior to the field study, data collectors were trained in estimating portion sizes of a variety of B Ration-type and T Ration foods and beverages. At the end of the five-day training, a linear regression analysis was done to determine the relationship between data collectors' estimates and actual portion sizes. The resulting regression equation for estimates of the food items ($y = B_0 + B_1x$, where y = estimate and x = actual) was $y = .031 + (.909 * x)$, $R^2 = 0.854$. An exact relationship would exist when $B_0 = 0$ and $B_1 = 1$. The equation for beverage estimates was $y = .023 + (.989 * x)$, $R^2 = 0.972$. From these results, it can be concluded that data collectors' estimates were closely related to actual portion sizes. Beverage estimates were even more closely related than food estimates.

A final questionnaire (see Appendix G) was used to determine overall opinions about the B Ration and the MRE. Overall acceptability of each item was rated on the 9-point hedonic scale described above. Satisfaction with other characteristics of the ration was measured on a 7-point scale, where 1 corresponds to "very dissatisfied" and 7 corresponds to "very satisfied."

Portion size of the different components of each ration was rated on a 7-point scale, where 1 corresponds to "portion much too small" and 7 corresponds to "portion much too large." Opinions about the variety of the ration, feelings of hunger and thirst, as well as other issues concerning the consumption of the B Ration and the MRE in a hot environment were also measured on the final questionnaire.

RESULTS AND DISCUSSION

Average Daily Intake

To determine if intake of the rations was sufficient to meet military nutritional standards, average daily consumption was calculated. These results are summarized in Table 1. The Military Recommended Dietary Allowances (MRDA) for an operational ration (e.g., B Ration, T Ration and MRE) are listed in Table 2. By comparing intake with the MRDA, it is apparent that consumption of the operational ration during the four-day evaluation period did not sufficiently meet military nutritional standards, with the exception of intakes of vitamin D, ascorbic acid, phosphorus, and potassium. Results of t-tests revealed that average consumption of all other nutrients as well as energy was significantly lower ($p < .001$) than the MRDA. Figures 1-5 illustrate daily consumption of carbohydrate, protein, fat, sodium and calories compared to the MRDA. Mean caloric intake was 2200 kcal, which is only 61% of the MRDA. Average intake from the rations ranged from 589-4365 kcal. Only four subjects

TABLE 1.

Average Total Daily Nutrient and Caloric Intake.

	<u>UNIT</u>	<u>DAY 1</u>	<u>DAY 2</u>	<u>DAY 3</u>	<u>DAY 4</u>	<u>OVERALL MEAN</u>
Energy	kcal	2240	2185	2209	2168	2201
Water**	g	1301	1522	1438	1535	1448
Carbohydrate	g	302	315	324	305	311
Protein	g	84.8	79.9	79.4	86.2	82.6
Fat	g	80.6	70.5	71.2	71.2	73.4
Cholesterol	mg	470	366	395	330	390
Calcium	mg	637	524	549	408	530
Phosphorus	mg	1142	1232	1030	1181	1147
Potassium	mg	2542	2510	2463	2320	2460
Sodium	mg	4463	4890	4260	3923	4387
Vitamin A	IU	2721	4306	1779	2792	2911
Ascorbic Acid	mg	73.9	74.3	151	115	103
Vitamin D *	mcg	40.7	23.9	9.58	10.8	21.5
Vitamin E *	mg	13.3	5.83	6.30	4.86	7.61
Iron	mg	18.5	14.8	15.6	13.2	15.5
Magnesium	mg	194	198	244	225	215
Zinc *	mg	3.01	4.07	3.70	4.08	3.71
Thiamin	mg	1.66	1.51	1.61	1.31	1.52
Riboflavin	mg	1.64	1.42	1.34	1.37	1.44
Niacin	mg	17.1	20.1	16.1	26.5	19.9
Vitamin B-6	mg	1.18	1.17	1.13	1.27	1.19
Folacin *	mcg	58.7	45.3	60.2	91.5	63.8
Vitamin B-12 *	mcg	0.002	0.014	0.003	0.015	0.009

* Values for these nutrients were only available for the B Ration and therefore only represent intake during breakfast and dinner.

** Water consumed from the food and beverages.

TABLE 2.

Nutritional Standards for Operational Rations. *

<u>Nutrient</u>	<u>Unit</u>	<u>Minimum Standard</u>
Energy	kcal	3600
Protein	g	100
Carbohydrate	g	440
Fat	g	160 (maximum)
Vitamin A	mcg RE **	1000
Vitamin D	mcg	10
Vitamin E	mg TE	10
Ascorbic Acid	mg	60
Thiamin	mg	1.8
Riboflavin	mg	2.2
Niacin	mg NE	24
Vitamin B-6	mg	2.2
Folacin	mcg	400
Vitamin B-12	mcg	3
Calcium	mg	800
Phosphorus	mg	800
Magnesium	mg	400
Iron	mg	18
Zinc	mg	15
Sodium	mg	5000 - 7000
Potassium	mg	1875 - 5625

* AFR 160-95.

** One microgram of retinol equivalent (mcg RE) equals 5 international units (IU).

CARBOHYDRATE

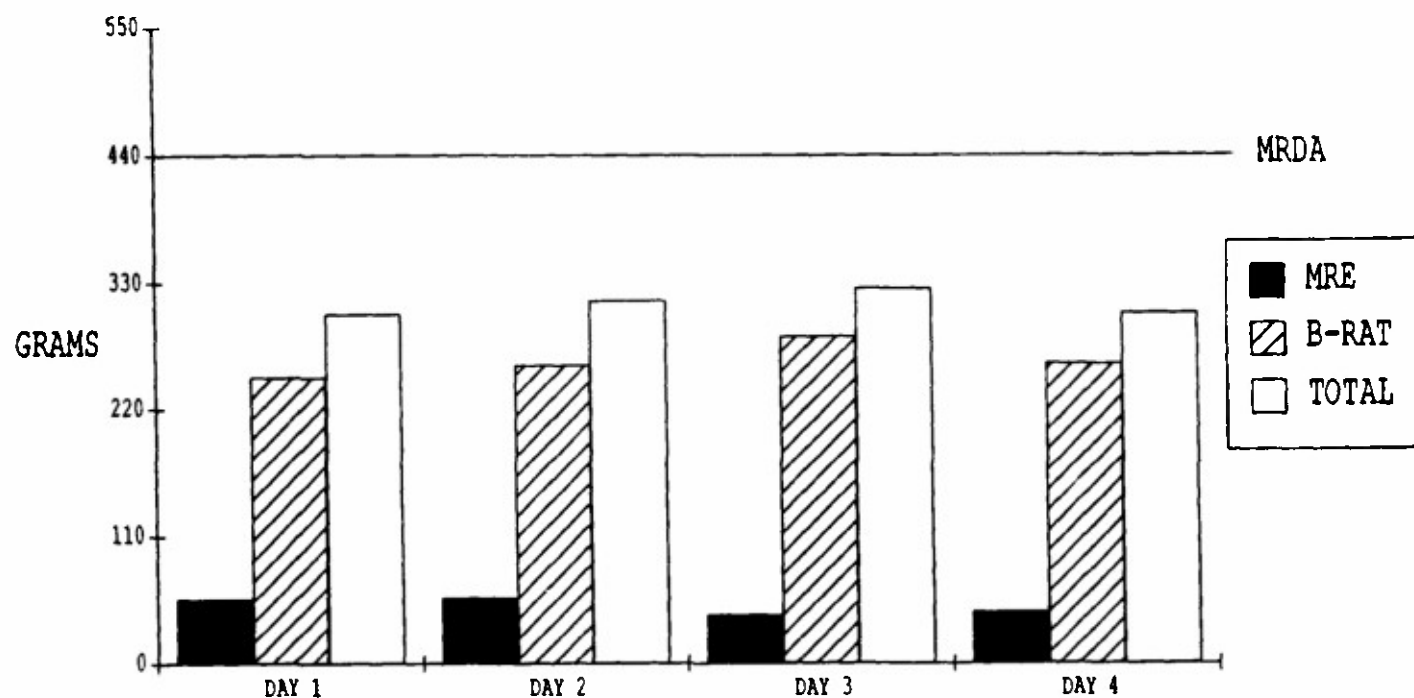


Figure 1. MRE, B Ration, and Total Daily Carbohydrate Consumption.

PROTEIN

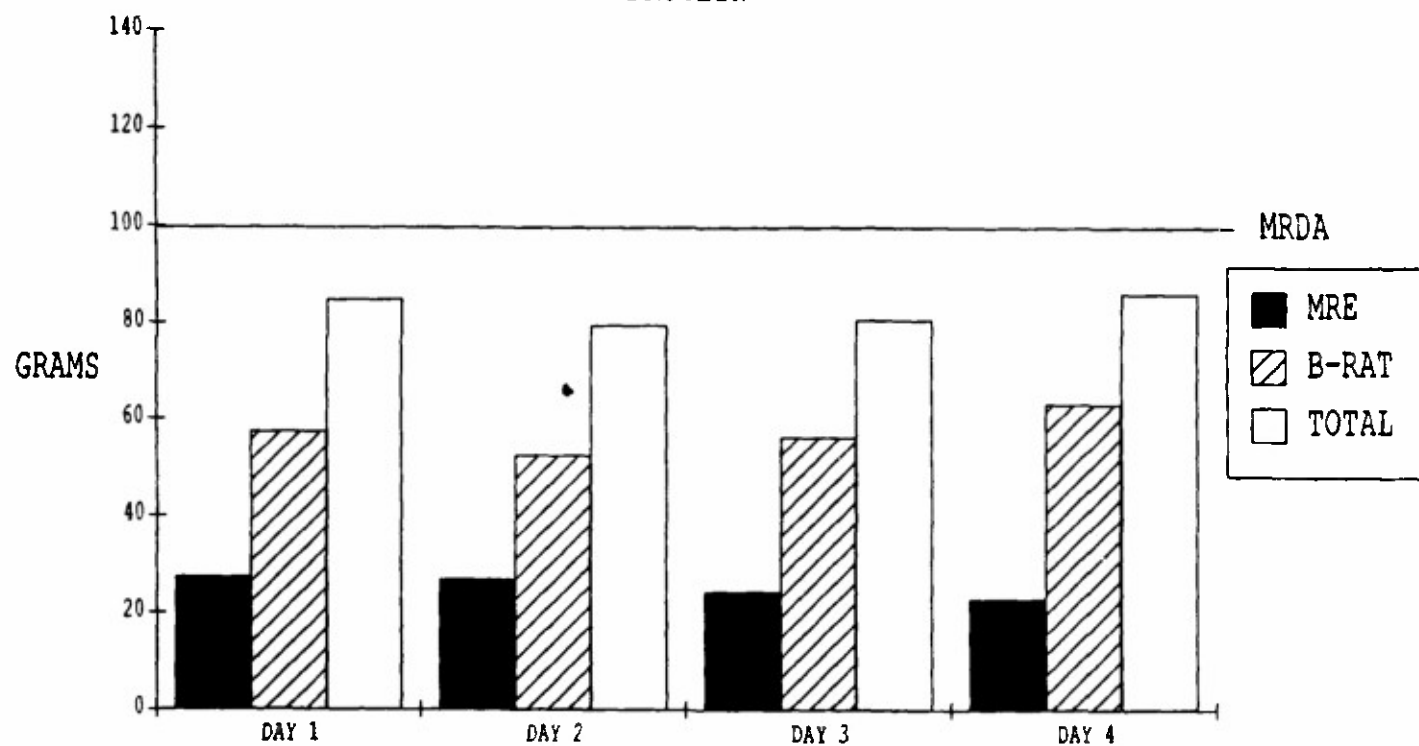


Figure 2. MRE, B Ration and Total Daily Protein Consumption.

FAT

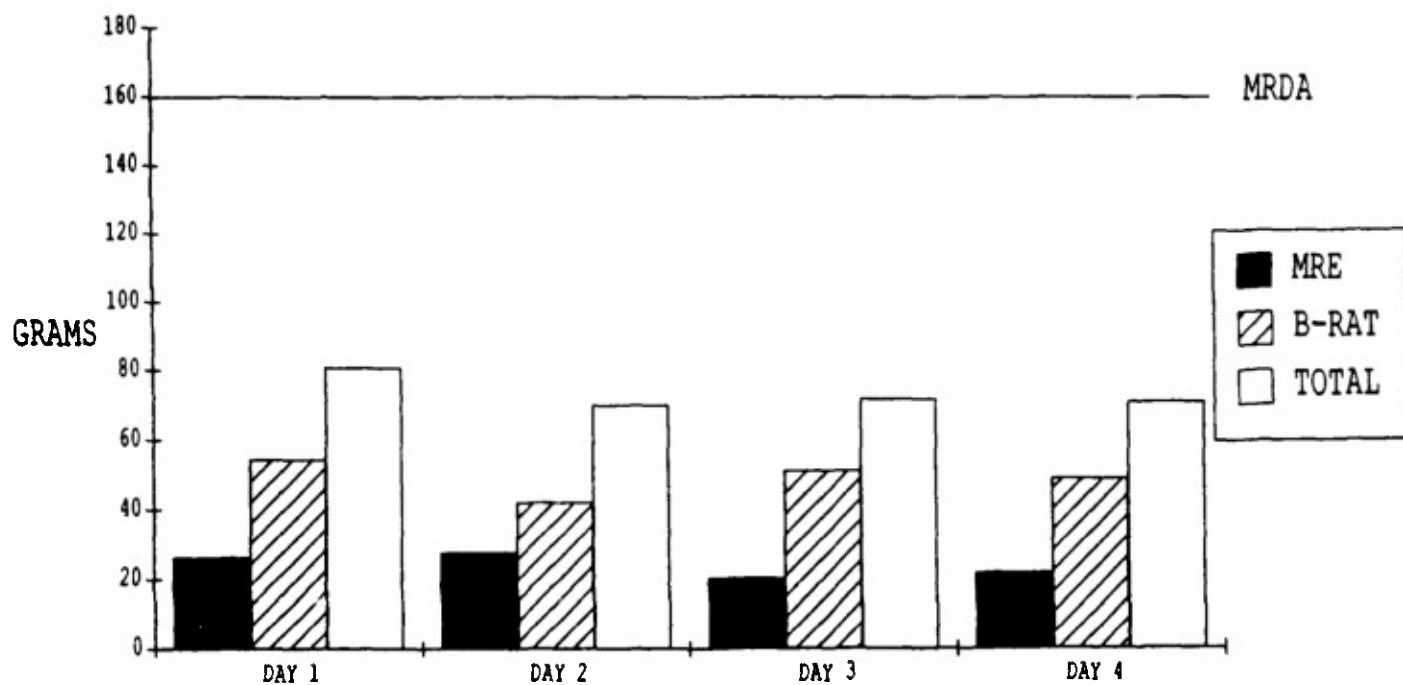


Figure 3. MRE, B Ration, and Total Daily Fat Consumption.

SODIUM

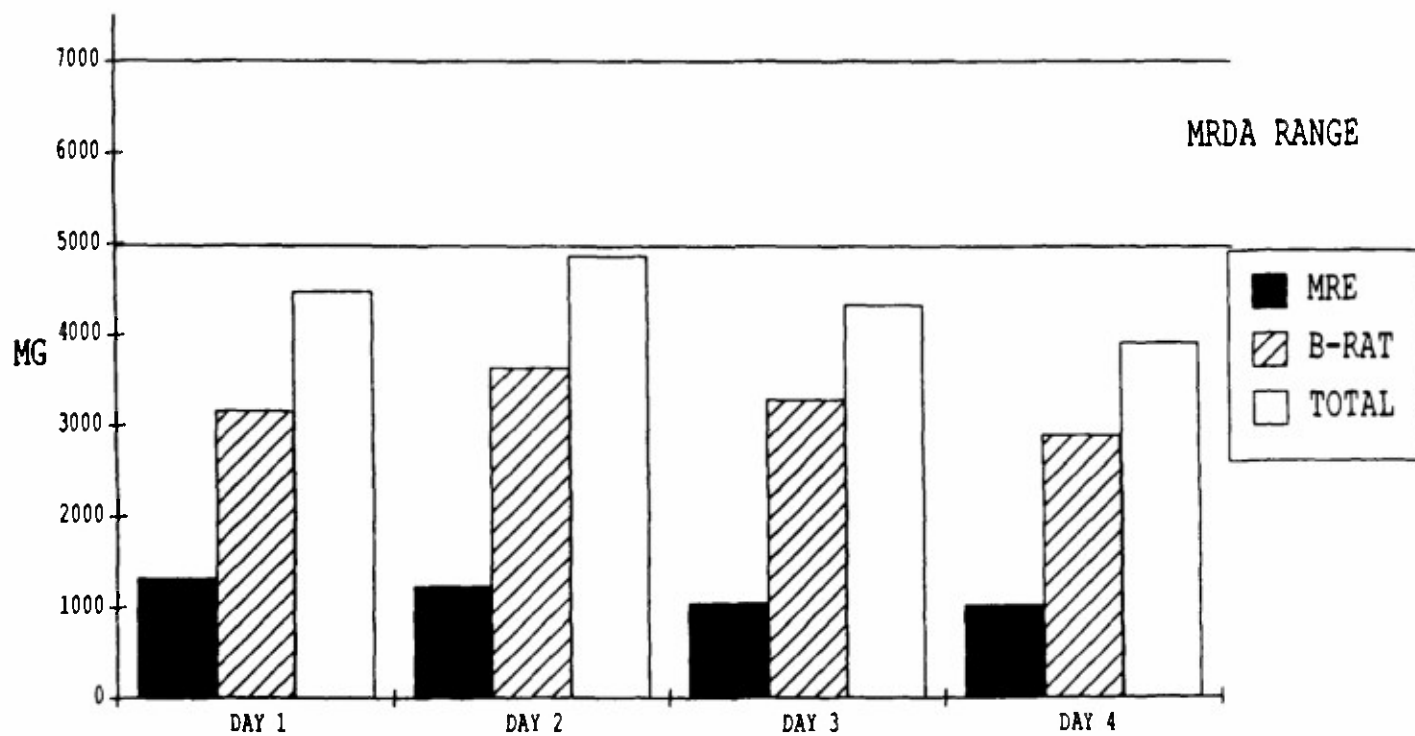


Figure 4. MRE, B Ration, and Total Daily Sodium Consumption.

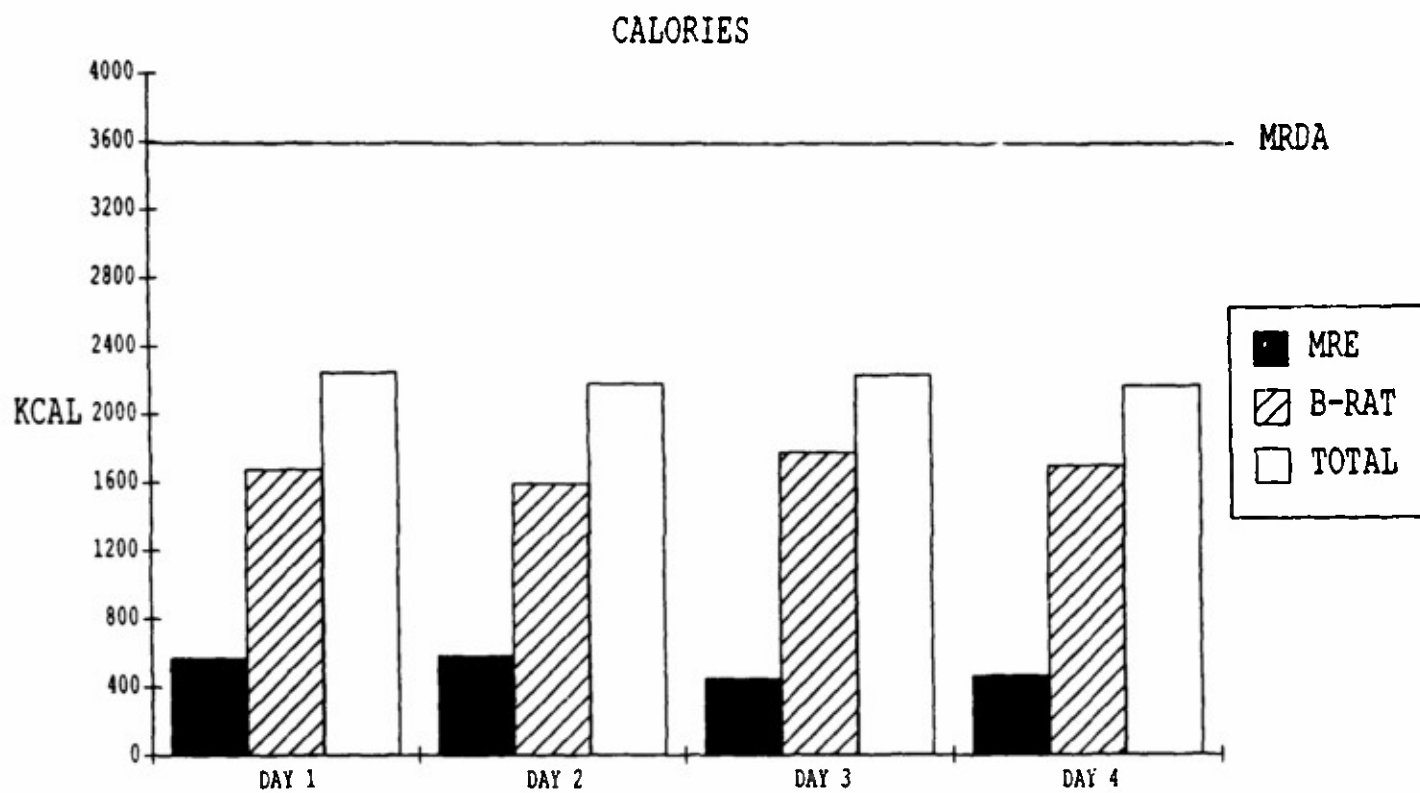


Figure 5. MRE, B Ration and Total Daily Caloric Consumption.

consumed at least 3600 kcal/day, which is the MRDA for energy. For a number of vitamins and minerals (e.g., calcium, magnesium, riboflavin, vitamin A, vitamin B-6) intake was similarly low. It must be noted that there were missing values for certain nutrients for some foods and beverages in the data base; means should be viewed as minimum values, particularly for those nutrients that were not included at all in the MRE data base (see Table 1).

Consumption of certain nutrients, such as sodium, fat and cholesterol, should be kept to a minimum. The average intake of cholesterol was 390 mg (see Figure 6), significantly higher than the 300 mg limit recommended by the American Heart Association. The majority of cholesterol was consumed from the B Ration at breakfast (see Figure 7). Reducing the frequency of serving eggs at breakfast would help to lower overall intake of dietary cholesterol.

The limited intake of calcium was related to the minimal consumption of milk products; for the most part, milk and cottage cheese. These items received low acceptability ratings. In order to make up for the lack in calcium intake, it may be necessary to increase the frequency of serving other B Ration foods high in calcium, which may be more acceptable, such as American cheese. However, there are very few other B Ration foods rich in calcium. It may be desirable to add other foods to the B Ration, which contain significant amounts of calcium. Cheese pizza, which is generally a well-liked item, is a food which could be added, given the ingredients currently available

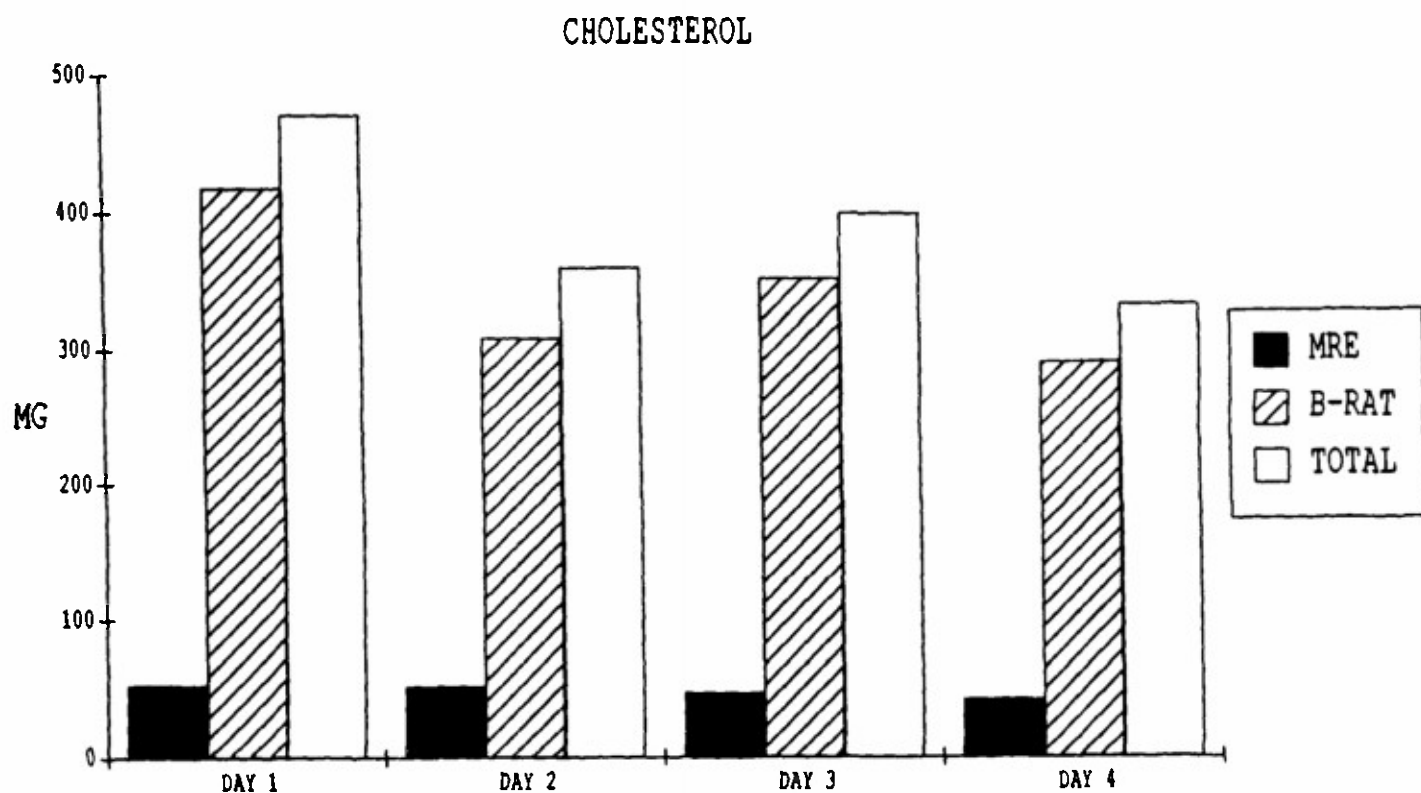


Figure 6. MRE, B Ration and Total Daily Cholesterol Consumption.

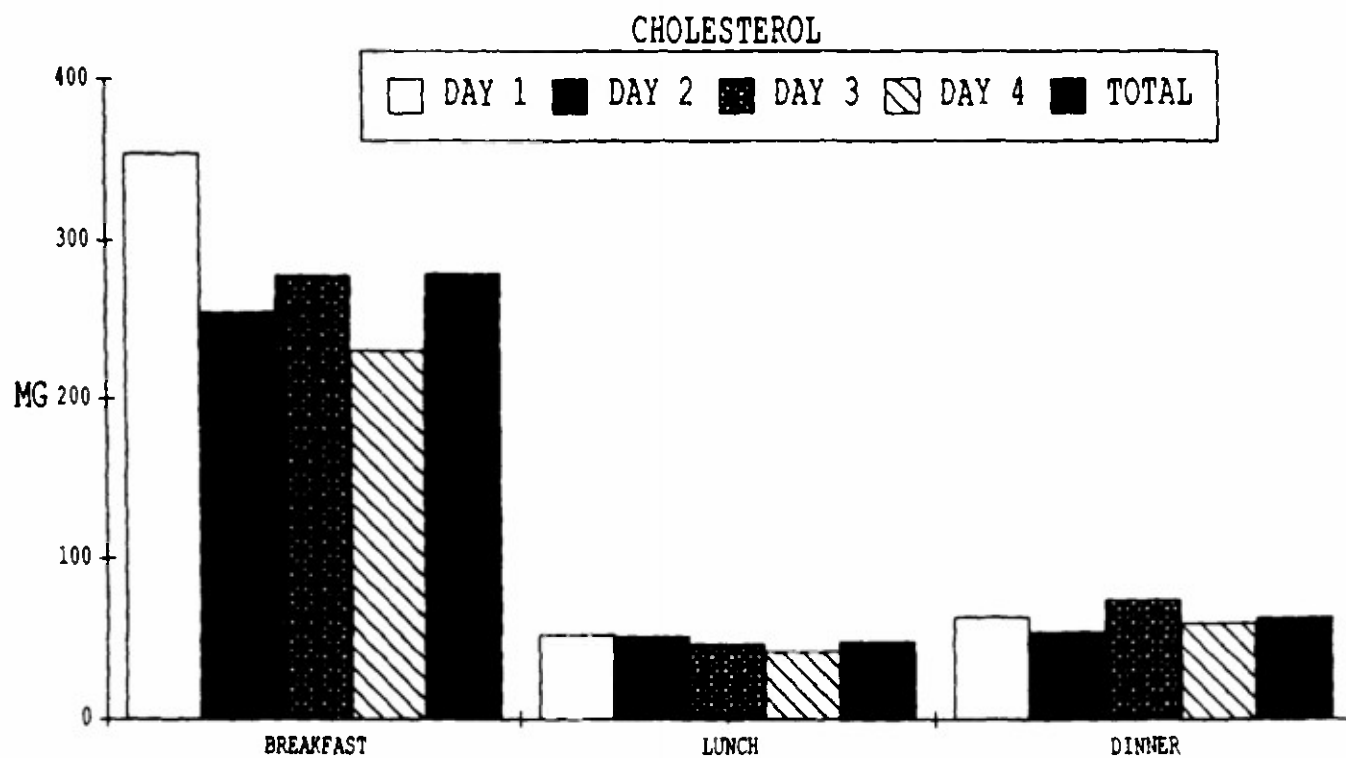


Figure 7. Average Cholesterol Intake at Each Meal During the 4 Day Period.

as part of the B Ration. An alternate solution would be to fortify other B Ration foods with calcium. It would also be possible to substitute T Ration lasagna for one of the B Ration entrees.

Airmen did not eat enough food, as was evidenced by the low daily intake of energy. Although increasing the consumption of certain foods and beverages would increase the intake of specific nutrients, increasing the total amount of ration foods consumed would significantly reduce the gap between intake and the MRDA of the majority of nutrients and energy.

Average Intake at Breakfast, Lunch and Dinner

To determine if the overall low energy intake was the result of low intake of a particular meal or ration, intake was analyzed separately by meal. These results can be found in Tables 3 - 5.

Tables 3 and 4 summarize the results of nutrient and caloric intake of the B Ration/T Ration at breakfast and dinner during the four-day evaluation period. (The intake data from breakfast on Day 5 were not included in the analysis because most subjects did not eat breakfast on the last day.) Table 5 summarizes nutrient and caloric intake of the MRE. Average intake of the B Ration at breakfast and dinner was 823 kcal and 863 kcal, respectively. Average intake at lunch was only 518 kcal. These results indicate that average intake of the MRE (V) was significantly lower than that of the B Ration.

In other MRE field studies in which the MRE (IV) was consumed for three meals per day, between 60 and 68% of the available calories in the MRE were consumed (1, 2). (The only

TABLE 3.

Average Nutrient and Caloric Intake of the B Ration for Breakfast.

	UNIT	DAY 1	DAY 2	DAY 3	DAY 4	OVERALL MEAN
Energy	kcal	942	808	794	747	823
Water*	g	531	499	489	556	519
Carbohydrate	g	133	115	121	109	119
Protein	g	25.1	24.6	19.9	21.5	22.8
Fat	g	36.3	28.4	27.3	25.8	29.4
Cholesterol	mg	354	254	278	230	279
Calcium	mg	325	214	230	184	238
Phosphorus	mg	413	431	299	429	394
Potassium	mg	1220	1080	1022	962	1071
Sodium	mg	1702	1754	1300	1372	1533
Vitamin A	IU	586	195	501	434	429
Ascorbic Acid	mg	45.1	32.5	87.9	75.0	60.0
Vitamin D	mcg	29.1	10.2	9.18	3.14	12.9
Vitamin E	mg	11.3	4.07	5.26	3.11	5.93
Iron	mg	6.37	5.43	5.71	5.38	5.72
Magnesium	mg	74.6	71.7	71.4	74.2	73.0
Zinc	mg	2.33	2.82	1.88	2.31	2.34
Thiamin	mg	0.480	0.327	0.500	0.394	0.425
Riboflavin	mg	0.677	0.535	0.518	0.496	0.557
Niacin	mg	4.08	4.93	3.76	4.58	4.34
Vitamin B-6	mg	0.296	0.291	0.360	0.366	0.328
Folacin	mcg	26.6	21.7	51.9	45.8	36.4
Vitamin B-12	mcg	0.002	0.002	0.003	0.004	0.003

* Water consumed from the food and beverages.

TABLE 4.

Average Nutrient and Caloric Intake of the B Ration for Dinner.

	<u>UNIT</u>	<u>DAY 1</u>	<u>DAY 2</u>	<u>DAY 3</u>	<u>DAY 4</u>	<u>OVERALL MEAN</u>
Energy	kcal	737	786	982	948	863
Water*	g	653	915	843	900	828
Carbohydrate	g	115	143	162	150	143
Protein	g	32.3	27.9	36.3	41.6	34.5
Fat	g	18.2	13.8	24.0	23.2	19.8
Cholesterol	mg	63.6	54.1	74.2	60.0	63.0
Calcium	mg	154	157	213	109	158
Phosphorus	mg	393	461	460	462	444
Potassium	mg	753	847	992	883	869
Sodium	mg	1454	1879	1979	1515	1708
Vitamin A	IU	935	3299	570	1644	1614
Ascorbic Acid	mg	10.6	26.4	54.8	31.0	30.8
Vitamin D	mcg	12.9	14.1	0.000	7.49	8.61
Vitamin E	mg	1.91	1.76	0.990	1.76	1.60
Iron	mg	7.94	5.17	6.77	4.49	6.09
Magnesium	mg	57.6	63.8	125	96.9	86.0
Zinc	mg	0.684	1.25	1.87	1.89	1.42
Thiamin	mg	0.281	0.417	0.564	0.290	0.389
Riboflavin	mg	0.442	0.388	0.452	0.473	0.439
Niacin	mg	6.51	8.71	7.31	16.0	9.62
Vitamin B-6	mg	0.124	0.228	0.277	0.392	0.255
Folacin	mcg	32.1	24.3	9.10	46.2	27.8
Vitamin B-12	mcg	0.000	0.012	0.000	0.012	0.006

* Water consumed from the food and beverages.

TABLE 5.

Average Nutrient and Caloric Intake of the MRE.

	<u>UNIT</u>	<u>DAY 1</u>	<u>DAY 2</u>	<u>DAY 3</u>	<u>DAY 4</u>	<u>OVERALL MEAN</u>
Energy	kcal	568	583	450	465	518
Water*	g	117	106	106	89	105
Carbohydrate	g	56.1	57.1	42.6	44.7	50.2
Protein	g	27.4	26.9	24.4	22.9	25.4
Fat	g	26.4	27.8	20.5	21.9	24.2
Cholesterol	mg	52.6	51.6	46.8	42.3	48.4
Calcium	mg	162	151	112	116	135
Phosphorus	mg	341	332	281	284	310
Potassium	mg	581	573	494	487	534
Sodium	mg	1316	1231	1044	1018	1154
Vitamin A	IU	1183	911	734	747	897
Ascorbic Acid	mg	17.5	16.3	12.6	12.4	14.7
Iron	mg	4.32	4.15	3.48	3.36	3.83
Magnesium	mg	63.3	61.9	50.6	53.6	57.4
Thiamin	mg	0.892	0.763	0.585	0.618	0.716
Riboflavin	mg	0.519	0.481	0.395	0.393	0.448
Niacin	mg	6.45	6.39	5.43	5.60	5.98
Vitamin B-6	mg	0.746	0.642	0.504	0.515	0.604

* Water consumed from the food and beverages.

difference between MRE IV and MRE V is the date of issue.) In a previous study in which the 'two B Ration/one MRE' schedule was used (3), 708 (58%) of the available kcal were consumed from the MRE. In the present study, subjects ate an average of only 43% of the available calories in one MRE. One explanation for the limited intake is that the acceptability ratings for some of the MRE foods were low, particularly for a number of the entrees. Average ratings of acceptability for individual MRE items can be found in Table 6; acceptability ratings by food group are summarized in Table 7. The majority of foods received ratings of '6' ("like slightly") or less. In past studies (1, 2), acceptability ratings of the MRE were notably higher.

Subjects may have consumed small amounts of food during lunchtime as well as at other times of the day because of the extreme heat and humidity. Temperature in the dining facility as well as atmospheric temperature and humidity levels were measured on a regular basis during the study (see Appendix H). The average temperature in the dining tent during breakfast hours was 77.7°F (25.4°C), during lunchtime, 89.8°F (32.1°C), and during dinner hours, 92.4°F (33.6°C). The average temperature in the field during the five days was 84.1°F (28.9°C). The average relative humidity in the field was 73%. The high temperatures, in combination with the high levels of humidity during the study indicate that the climate was extremely hot; the Wet Bulb Global Temperature (WBGT Index) was 85-87°F during several hours of each day, indicating risk of heat stress.

TABLE 6.

Mean Acceptability Ratings of MRE Foods. *

	<u>MEAN</u>	<u>SD</u>
Beef w/spiced sauce	7.558
Turkey with gravy	7.1	1.4
Ham slices	6.6	1.7
Chicken ala king	6.1	1.9
Beef w/BBQ sauce	5.9	1.6
Beef stew	5.8	1.5
Frankfurters	5.6	2.1
Meatballs w/BBQ sauce	5.5	2.0
Ham/chicken loaf	5.5	1.8
Beef w/gravy	4.8	2.3
Beef patties	4.0	2.1
Pork patties	3.9	2.7
Applesauce	6.8	1.5
Fruit mix	6.2	1.6
Peaches	5.8	2.2
Beans w/tomato sauce	6.4	1.5
Crackers	5.9	1.5
Potato patty	5.3	2.0
Orange nut cake	5.9	1.8
Chocolate covered cookie	5.9	2.0
Chocolate nut cake	5.7	2.3
Cherry nut cake	5.6	1.9
Brownie	5.3	1.9
Maple nut cake	5.2	2.2
Pineapple nut cake	5.1	2.1
Fruitcake	4.5	2.3
Caramel candy	7.892
Chocolate fudge candy	6.396
Vanilla fudge candy	4.7	3.2
Miscellaneous candy	4.7	2.1
Cocoa	4.5	3.0
Peanut butter	6.0	1.8
Cheese spread	5.9	1.6
Jelly	5.8	2.1

* 1 = Dislike Extremely ... 9 = Like Extremely

TABLE 7.

Mean Acceptability Ratings of the MRE by Food Group. *

	<u>MEAN</u>	<u>SD</u>
ENTREES	5.5	1.5
STARCHES	6.1	1.4
SPREADS	6.0	1.4
FRUITS	6.0	2.0
DESSERTS	5.4	1.8
CANDY	6.1	2.5
BEVERAGES	4.8	2.7

* 1 = Dislike Extremely ... 9 = Like Extremely

In addition to intake being low at lunchtime, intake at the dinner meal was also significantly less than in previous studies. For example, in an Army study in which the two 'B Ration/one MRE' schedule was used (3), average intake of the B Ration at dinner was 1234 kcal, compared to 863 kcal in the present study. As will be discussed later in this report, the B Ration was well-liked overall. With the exception of several of the entrees and vegetables, the items liked the least were items served during breakfast. Therefore, the acceptability of the ration does not seem to explain the comparatively low intake at dinner in the present study.

An alternate explanation for the limited consumption of the B Ration at dinner is that a number of sources of nonration foods were available to the airmen. Although participants were asked to refrain from eating any nonration food, it was apparent that

they did consume other foods and beverages, which they brought with them or which they obtained from vending machines and other sources. Subjects were asked to write down any foods and beverages they consumed between meals on their intake forms. Although some subjects ate leftover foods from their MRE between meals, the majority of items listed consisted of nonration foods such as pizza, chips, nuts, cookies, candy and soda. Most of these foods were consumed in the afternoon before dinner or in the evening.

In past field studies (1, 2, 3), which were conducted in more isolated sites, nonration foods were not available. Without the consumption of these additional foods in the present study, the overall average daily intake of the rations, and particularly intake of the dinner meal, might very possibly have been higher.

The consumption of nonration items has further implications for the results of the present study. Only data from consumption of rations during meals are included in the preceding graphs and tables. From the information reported by subjects on their consumption forms, it was determined that some airmen ate between 1000 and 2000 additional calories between meals. Since the protocol required consumption of the B Ration and MRE only, it is also possible that much of the nonration foods eaten during the evaluation was not reported. For these reasons, some subjects may, in fact, have consumed the MRDA for energy and perhaps some nutrients. However, many of these subjects were probably still deficient in a number of vitamins and minerals, since the

majority of the nonration items consumed were foods and beverages consisting mainly of "empty" calories.

Beverage Intake

Beverage intake was estimated by data collectors at breakfast and dinner. Beverages available at breakfast included water, coffee, juice, and milk. Beverages served at dinner included water, coffee, and flavored beverages. (Appendix C lists the beverages served on each day.) Average total beverage intake at breakfast and dinner are summarized in Table 8. The only beverages available during lunch were coffee, cocoa and water. Because of the hot weather, and because no means was available to heat water, intake of coffee and cocoa was very low at lunch. Less than 10% of subjects drank either of these beverages at lunch. Subjects estimated their intake of water on their consumption forms. However, most subjects did not distinguish between water intake "during" and "between" meals. Therefore, water intake during lunch could not be accurately determined. Water intake during lunch and between meals is reported in the following section.

Possibly because of the lack of beverages available in the MRE, over 60% of the subjects reported that they drank at least one can of soda (e.g., Coca Cola, Sprite) each day. Several subjects had as many as 7-11 cans of soda per day. The average daily consumption of soda was 24.9 ounces, or approximately two cans of soda per day. These results emphasize the need to include a greater variety of beverages in the MRE, particularly

TABLE 8.

Average Beverage Consumption at Breakfast and Dinner.

<u>Day</u>	<u>Breakfast</u> (g)	<u>Dinner</u> (g)
1	418	496
2	424	543
3	475	651
4	476	611
Average	448	576

for consumption in hot-weather environments. The most recent procurements of the MRE (VII and VIII) include flavored beverage powders. This should enhance beverage consumption in future field studies, and may possibly reduce the consumption of nonration beverages (if they are available) in the field.

Water Intake Between Meals

In addition to estimating food and beverage consumption, subjects also estimated how much water they drank at lunch and between meals on their consumption forms. On Day 1, subjects estimated, on average, that they drank about one canteen of water at lunch and between meals. Only about 32% reported drinking water at lunch or between meals on this day. Since this was the first day of the study, they were not familiar with filling out the questionnaires; consequently, this may not be a true estimate of water intake during lunch and between meals for Day 1. On Day 2, airmen consumed an average of two and one half canteens of water at lunch or between meals. On Day 3, the mean was

approximately three canteens. The average water intake on Day 4 was about four and one half canteens.

In a previous Army study (1), the average amount of drinking water consumed per day in three different MRE groups (MRE IV, VII, VIII) was 3014 mL, 2502 mL, and 2610 mL, respectively. In another study (2), the MRE group drank 2383 mL, and the 'two A Ration/one MRE' group drank 1462 mL of water per day. In the present study, subjects drank an average of approximately 2950 mL of water at lunch and between meals. This amount, added to the 1000+ mL of additional fluid consumed, on average, at breakfast and dinner, seems to exceed overall water intake from plain drinking water and other beverages in comparison to past studies. However, additional fluid was needed because of the extreme hot and humid environment and the moderate to high activity level maintained during the day.

When subjects were asked to describe their level of physical activity during the week of the study, 43% said they engaged in heavy daily physical activity, 37% engaged in moderate physical activity, 9% in light physical activity, and 11% said their activity level was mixed.

When asked about their overall feelings of thirst during the study, 46% felt they got enough to drink, 28% were sometimes thirsty, 20% were often thirsty, while 7% responded that they were thirsty almost all of the time. Even though average fluid intake during the study seems sufficient, for about 27% of the airmen, thirst was a problem. The addition of flavored beverage powders to the MRE should alleviate this problem.

Effect of Beverage Variety on Beverage Consumption

The effect of beverage variety on beverage intake was investigated during the dinner meal. On Days 1, 2, and 4, only one flavored beverage was served at dinner, either cherry, grape or lemonade (the no variety condition). On Day 3, all three flavors were served (the variety condition). Both water and coffee were also available at each meal. Total beverage intake per meal was calculated. Total beverage intake at dinner (this includes intake of the flavored beverages as well as water and coffee) was 496 g, 543 g, 651 g, and 611 g, on Days 1-4, respectively (see Table 8, p. 27). Table 9 shows total intake of just the flavored beverages during the dinner meal. Analysis of variance revealed a significant difference ($p < .001$) in total beverage intake and in intake of the flavored beverages among the four days. A post-hoc Student-Newman-Keuls test found that intake on Day 3 (variety) was significantly different ($p < .05$) than intake on Days 1 (cherry) and 2 (grape); it was not significantly different from intake on Day 4 when lemonade was served. Consumption of beverages on Days 1 and 4 was also significantly different ($p < .05$).

That intake did not differ on Days 3 (variety) and 4 (lemonade only) may be explained by the fact that the serving temperature of lemonade, for some unknown reason, was lower than the serving temperatures of the other beverages (lemonade - 46°F (8°C), cherry - 69°F (21°C), and grape - 64°F (18°C)). In past studies (16, 17), the preferred temperature of flavored beverages was found to be 40°F (4°C). The cooler temperature of the

lemonade may account for higher intake on day 4 than on the other "no variety" days.

TABLE 9.

Mean Acceptability Ratings and Intake of Flavored Beverages During the Dinner Meal.

<u>Day</u>	<u>Beverage Flavor</u>	<u>Average Intake (g)</u>	<u>Rating*</u>
1	Cherry	461	7.08
2	Grape	498	6.85
3	Cherry	641	7.62
	Grape		7.24
	Lemonade		8.00
4	Lemonade	574	7.31

* 1 = Dislike Extremely ... 9 = Like Extremely

There appears to be some evidence that beverage intake was highest on Day 3 because of the increased variety of beverages available. However, other factors may have also contributed to increased beverage consumption on that day. For example, although an attempt was made to serve equally palatable foods at each meal, on Day 3, the entrees received very high acceptability ratings (see Table 10, p. 35). The high acceptability ratings of the entrees served on Day 3 may have contributed to greater acceptability of the flavored beverages on that day than on the other days (see Table 9), and subsequently, increased consumption. Past research has shown that acceptability of the entree has a significant effect on the acceptability of the rest of the meal (25). In addition, the high acceptability ratings of the entrees may have contributed to greater consumption of food

during the meal, which subsequently may have resulted in greater beverage intake.

Because many variables that may have contributed to the increased beverage intake on the variety day could not be held constant, such as the acceptability of the entrees served on each day, the subjects' preferences for the various beverages, temperature and humidity on each day, and subjects' activity levels, it is difficult to conclude which factors were responsible for the increased intake. However, laboratory research has indicated a relationship between beverage variety and intake. The results of this study also suggest that beverage variety may enhance beverage consumption.

Effect of Flavorants on the Acceptance and Consumption of Milk

Adding flavorants to the warm milk (the average serving temperature of the milk was 65°F (18°C)) did not have a positive effect on acceptability and did not enhance milk consumption. The milk was given extremely low ratings. On Day 1, plain milk was served with breakfast; only 24 subjects tasted the milk, and these subjects rated it poorly. This is consistent with acceptability data of plain, nonfat dry milk collected in a taste-testing study and served at a comparable temperature (17). On Day 2, only 14 airmen (18% of the subjects) tasted the chocolate-flavored nonfat dry milk. It, too, received low acceptability ratings. On subsequent days, 8 or fewer subjects (10% of the total) selected milk to drink at breakfast.

Although the acceptability data for the flavored milk is inconsistent with the laboratory data which showed that adding flavorants to warm milk increases its acceptability (17), the small number of subjects does not allow valid comparisons to be made. In future studies of food acceptability in a cafeteria-style setting, the protocol should encourage all subjects to at least taste all foods and beverages that are being evaluated.

Another factor which could be investigated in future studies is the effect of ambient temperature as well as beverage temperature on beverage acceptability. The temperature in the dining facility may have contributed to the low acceptability ratings of the milk (the average ambient temperature during breakfast was 77.7°F, 25.4°C). Previous studies were conducted in a laboratory setting at room temperature (16, 17).

Effect of Meal Scheduling on Intake of the MRE

An analysis of variance was done to determine if there were any differences in intake between the scheduled and nonscheduled lunch groups. No significant differences were found for intake of calories, water, protein, fat or carbohydrate. Therefore the data were collapsed across conditions to compute the average intake of the MRE reported in Table 5.

The finding that meal scheduling did not affect intake supports research done by Schacter (23) in which college students' intake of dinner was compared during weekdays (presumably scheduled) and weekends (presumably less scheduled).

He found that subjects ate dinner just as frequently at either time of the week. Schacter postulates that people of normal weight seem to be influenced by internal cues of hunger rather than by external cues such as meal schedules. This phenomenon may explain the results of the present study.

Validation of Consumption Estimates

Consumption of the B Ration was measured by the visual estimation or plate waste visual assessment method (26, 27). To evaluate the accuracy of this method in the present study, a multiple regression analysis was done to determine the agreement between data collectors' estimates of plate waste and actual plate waste. For estimations of food, the resulting regression equation ($y = B_0 + B_1x$, where y = estimate and x = actual) was $y = 0.060 + (0.80 * x)$, $R^2 = 0.80$. An exact relationship would exist when $B_0 = 0$, and $B_1 = 1$. When estimating plate waste of food, when 0.3 or less of the portion was leftover, data collectors tended to slightly overestimate, within 6% of the actual value. When more than 0.3 of the portion was leftover, data collectors tended to underestimate plate waste. From 0.3 to 0.6 of a portion, underestimations were within 6% of actual values; when more than 0.6 of a portion was leftover, estimates were somewhat less accurate, but within 14% of actuals. In general, estimates of food correlated well with actual values. For beverages, data collectors' estimates and actual measurements were almost exactly the same ($y = 0.001 + 1.01x$, $R^2 = 0.98$). These results indicate

that the method used during this study was an efficient and valid method of measuring food consumption.

Acceptability of the B Ration

Mean acceptability ratings of the B Ration/T Ration are provided in Table 10. The ration was generally well-liked with the exception of some of the breakfast items and the dairy products. The B Ration foods that were liked the most were creole shrimp, creole chicken, bread (this was a store-bought item), fruit cocktail, pineapple, water, lemonade, cherry-flavored beverage, peanut butter and jelly. The T Ration foods that were well-liked were pepper steak with sauce and peas with mushrooms. The B Ration foods disliked the most were the grilled breakfast meat, scrambled eggs, hash brown potatoes, cottage cheese, peaches, and the milks, both plain and flavored. Acceptability ratings of the B Ration/T Ration by food group are shown in Table 11.

The flavored beverages received high acceptability ratings even though the temperatures at which they were served were fairly high, with the exception of lemonade (lemonade - 46°F (8°C), cherry - 69°F (21°C), and grape - 64°F (18°C)). In past studies (16, 17), the preferred temperature of flavored beverages was found to be 40°F (4°C). No ice was available to add to the drinks. Water received even higher ratings; however, the water was cold because it was dispensed from a water fountain. The milk, as discussed previously, was not well-accepted, although only a small number of subjects actually tasted it.

TABLE 10.

Mean Acceptability Ratings of B Ration Foods. *

	<u>MEAN</u>	<u>SD</u>
French toast	6.9	1.3
Bacon	6.4	1.3
Grits	6.3	1.4
Pancakes	5.7	1.5
Hash brown potatoes	4.9	1.7
Scrambled eggs	4.6	1.8
Grilled breakfast meat	4.4	2.3
Creole shrimp	7.5	1.3
Creole chicken	7.1	1.1
** Pepper steak w/sauce	7.0	1.1
** Turkey slices w/gravy	6.5	1.9
Fried fish	6.3	1.3
** Roast beef with gravy	5.9	1.9
** Beef with BBQ sauce	5.6	2.2
Beefsteak with gravy	5.6	2.8
Macaroni and cheese	5.4	2.0
** Peas with mushrooms	7.0	1.3
Peas	6.8	1.8
Carrots and peas	6.7	1.2
Corn	6.7	1.4
Green beans	6.5	1.5
** Mixed vegetables	6.5	1.6
Succotash	5.5	1.8
Mashed potatoes	6.6	1.7
Rice	6.4	1.7
White bread	7.6	1.3
Biscuits	6.1	1.5
Cornbread	5.5	2.2
Fruit cocktail w/pears	7.8	1.1
Pineapple	7.5	.84
Fruit cocktail	7.4	1.3
Peaches	4.7	2.3
Cottage cheese	3.9	2.5
Water	8.0	1.2
Lemonade	7.5	1.3
Cherry-flavored beverage	7.3	1.4
Grape-flavored beverage	6.9	1.4
Tomato juice	6.8	3.0
Pineapple juice	6.8	1.7
Grapefruit juice	6.7	2.0
Apple juice	6.7	1.4
Grape juice	5.7	1.9

Orange juice	5.5	2.2
Strawberry milk	3.3	1.9
Plain milk	2.7	1.9
Chocolate milk	2.0	1.4
Coffee	6.7	1.2
Oatmeal cookies	6.9	1.6
Brownies	6.7	1.4
White cake	6.6	1.7
Coffee cake	6.6	1.2
Chocolate pudding	6.3	2.3
Peanut Butter	7.8	1.1
Jam, jelly	7.4	1.3
Syrup	6.6	1.5
Turkey gravy	6.0	2.4

* 1 = Dislike Extremely ... 9 = Like Extremely
 ** T Ration items.

TABLE 11.

Mean Acceptability Ratings of the B Ration
 by Food Group. *

	<u>MEAN</u>	<u>SD</u>
BREAKFAST FOODS	5.6	1.3
ENTREES (Dinner)	6.2	1.2
VEGETABLES	6.5	1.1
STARCHES	5.8	1.2
BREADS	6.9	1.4
SPREADS	7.4	1.3
FRUITS	7.1	1.5
DESSERTS	6.6	1.4
FLAVORED BEVERAGES	7.3	.98
JUICES	6.1	1.6
MILKS	2.6	1.6

* 1 = Dislike Extremely ... 9 = Like Extremely

Overall Opinions of the B Ration and MRE Elicited from the Final Questionnaire

The final questionnaire used in this study (see Appendix G) was very similar to the final questionnaire used to evaluate the MRE in other field studies conducted in 1983 and 1986 (1, 2). When applicable, the results of the present study will be compared to these studies. In the present study, MRE V was used; in the 1983 and 1986 studies (1, 2), MRE IV was used. However, the only difference between MRE IV and V is the date of issue; the formulation and components of the ration are the same.

Subjects were asked to rate the overall acceptability of each B Ration item and each MRE item that was served during the five days of the study. Mean acceptability ratings for the B Ration and MRE are summarized in Tables 12 and 13, respectively.

In the 1983 Army study (3), the B Ration was also evaluated. The acceptance of individual food items at the dinner meal was rated by subjects. Most items received neutral ratings or were disliked slightly in the 1983 study, while almost all items were liked in the present study.

It should be noted that the B Ration used by the Army is slightly different than the Air Force's B Ration. In addition, new versions of the ration were issued by both the Army and the Air Force in 1984. Given this information, it is interesting that subjects in the present study ate less at the dinner meal than in the previous study (863 kcal versus 1234 kcal), even though they liked the B Ration better. This lends further credence to the idea that airmen ate less because they had access

TABLE 12.

Mean Acceptability Ratings of B Ration Foods
Final Questionnaire. *

	MEAN	SD
French toast	6.7	1.7
Bacon	5.9	2.0
Pancakes	5.8	1.8
Grilled meat	3.9	2.3
Scrambled eggs	3.5	2.0
Creole shrimp	6.9	2.2
Creole chicken	6.7	1.8
** Pepper steak	6.6	1.7
** Turkey slices w/ gravy	6.3	1.8
** Roast beef with mushroom gravy	5.9	2.2
Fried fish	5.4	2.4
Beefsteak with gravy	5.3	2.5
** Beef with BBQ sauce	4.8	2.2
White bread	7.2	1.6
Mashed potatoes	6.2	1.9
Rice	6.0	1.9
Coffee cake	5.9	2.3
Cornbread	5.6	2.3
Macaroni and cheese	5.2	2.1
Biscuits	5.1	2.2
Grits	4.3	2.6
Hash brown potatoes	4.1	2.3
Jam, jelly	7.4	1.4
Peanut butter	6.9	2.0
Syrup	6.7	1.7
Corn	6.7	1.4
** Mixed vegetables	6.1	2.0
** Peas with mushrooms	6.1	1.8
Peas	6.1	2.1
Carrots and peas	6.0	2.0
Green beans	5.4	1.9
Succotash	4.5	2.2
Cottage cheese	3.0	2.3
Fruit cocktail salad	7.2	1.7
Pineapple	6.7	1.8
Peaches	6.5	2.0
Oatmeal cookies	6.8	1.9
Chocolate brownies	6.3	1.8
Chocolate pudding	6.1	2.5
White cake	6.1	2.0
Yellow cake	5.9	2.1

Coffee	6.6	...	1.7
Grapefruit juice	5.4	...	2.1
Orange juice	5.2	...	2.4
Milk, strawberry	2.0	...	1.8
Milk, plain	1.7	...	1.4
Milk, chocolate	1.5	...	1.1
Lemonade beverage	7.4	...	1.5
Cherry beverage	6.9	...	1.7
Grape beverage	6.9	...	1.4

* 1 = Dislike Extremely ... 9 = Like Extremely
 ** T Ration items.

to alternate food sources and were consuming other foods in addition to the ration.

In general, the MRE was given lower acceptability ratings in the present study than in previous evaluations. There are several possible explanations for these differences. As was mentioned previously, the only food available for the experimental group in the 1983 (a 34-day test) and 1986 (an 11-day test) field studies was the MRE. In the present study, the B Ration and nonration foods were consumed. Perhaps the MRE is more acceptable if there is no alternative, particularly for long periods of time. The two previous studies were conducted at more isolated sites where other sources of food were unavailable. The previous tests were also conducted in a temperate climate; the MRE may be more acceptable in a temperate climate than in a hot climate.

Paired t-tests were done to determine if field test acceptability ratings of the B Ration and MRE were similar to posttest ratings (from the final questionnaire). Only subjects who had rated foods at both of these times were included in this

TABLE 13.

Mean Acceptability Ratings of MRE Foods
Final Questionnaire. *

	<u>MEAN</u>	<u>SD</u>
Chicken ala king	5.5	2.3
Turkey with gravy	5.4	2.3
Beef with gravy	5.3	2.1
Meatballs with BBQ sauce	5.3	2.4
Beef stew	5.2	2.0
Ham slices	5.0	2.3
Beef with BBQ sauce	4.8	2.2
Ham/chicken loaf	4.8	2.1
Beef with spiced sauce	4.7	2.4
Frankfurters	4.6	2.5
Beef patties.....	3.1	2.3
Pork sausage patties	2.9	2.6
Beans with tomato sauce	5.7	2.1
Crackers	5.6	2.0
Potato patty	3.6	2.3
Jelly	5.7	2.2
Peanut butter	5.7	2.2
Cheese spread	4.8	2.1
Applesauce	6.0	2.0
Mixed fruits	5.5	2.2
Peaches	4.9	2.3
Strawberries	4.4	2.8
Chocolate-covered cookie	5.4	2.2
Brownie	4.6	2.3
Chocolate nut cake	4.4	2.6
Maple nut cake	4.2	2.5
Cherry nut cake	4.0	2.5
Fruitcake	3.7	2.7
Pineapple nut cake	3.6	2.6
Orange nut cake	3.5	2.6
Coffee	4.8	2.6
Cocoa	4.5	2.9
Caramel	6.0	2.2
Chocolate fudge	4.6	2.2
Vanilla fudge	4.5	2.6
Chocolate toffee	3.7	2.4
Chocolate with almonds	3.7	2.4
Starch jelly bar	3.3	2.0
Chocolate covered coconut	2.9	2.4

* 1 = Dislike Extremely ... 9 = Like Extremely

analysis. It was found that a number of food items were rated significantly higher during the test than after the test, i.e., foods were given higher acceptability ratings while they were being eaten than when they were rated at a time when the foods were not present. Similar results have been obtained in the past (1).

The difference between during-the-field-test and posttest acceptability ratings may be explained by a number of psychological mechanisms. One possible explanation could involve the general perception of operational rations. When subjects were given the list of foods to rate on acceptability on the final questionnaire, they may have tended to give the foods low ratings because of an overall negative perception of operational rations, or because they were using nonration food as a frame of reference. But when the foods were rated during meals at the same time at which they were eaten (i.e., during the field test), they were rated more positively. This may reflect some rationalization (i.e., "If I am eating this, then it must be good."). The few foods that were rated slightly higher on the final questionnaire than during the test, were foods that are typically viewed as "tasting good."

The final questionnaire asked airmen about overall hunger during the week of the study. Thirty-three percent of the subjects responded that they had enough to eat during the week, while 42% felt hungry some of the time, and 24% were often hungry. One possible explanation for feeling hungry could be

that airmen were not served sufficient quantities of food. The issue of portion size was addressed on the final questionnaire.

The majority of respondents felt the portions of both rations were either just right or too small. They were more satisfied with portion size in the B Ration than the MRE. In the previous field studies (1,2), soldiers also found the MRE portion sizes to be somewhat small. The most recent procurement of the MRE (MRE VIII) includes larger portions of entrees (8 oz. vs. 5 oz.). The mean ratings for portion size can be found in Table 14.

TABLE 14.

Mean Ratings of Portion Size - B Ration and MRE.*

	<u>B RATION</u>	<u>MRE</u>
DINNER ENTREES	3.3	2.5
STARCHES	3.6	3.0
DESSERTS	3.8	2.8
FRUITS	3.6	2.8
VEGETABLES (B Ration only)	3.8	
SPREADS	3.7	3.2

* 1 = Portion Size Much Too Small ... 7 = Portion Size Much Too Large

In general, the airmen's ratings of portion size do not seem to explain the hunger they experienced during the evaluation. Given their low average energy intake (see Table 1), it is no surprise that they felt hungry at times during the study. Rather than not having enough to eat, it seems clear that many subjects did not consume all that was served to them, especially for lunch (the MRE). The reasons that they did not eat enough can be partially explained by the low acceptability ratings of some of

the foods served during the evaluation period. In addition to several reasons already expounded upon, the responses to some of the other questions on the final questionnaire may also explain the limited food intake.

Subjects were asked to rate their satisfaction with various aspects of the B Ration on a 7-point scale. Fifty-three percent of the subjects were satisfied (i.e., ratings greater than '4') with the flavor of the B Ration, 60% were satisfied with its appearance, 67% were satisfied with the amount of food in the B Ration, 51% were satisfied with the amount of variety between meals, and 59% were satisfied with the nutritional value of the ration.

Satisfaction with these factors of the MRE was rated on the same 7-point scale. Subjects responded with significantly lower ratings for the MRE: only 19% were satisfied with the flavor of the MRE, 12% with its appearance, 26% with the amount of food in the ration, 26% with variety between meals, and 27% with its nutritional value. The means for each factor are summarized in Table 15.

TABLE 15.

Mean Satisfaction Ratings, B Ration and MRE. *

	<u>B RATION</u>	<u>MRE</u>
FLAVOR OF FOOD	4.3	3.1
APPEARANCE OF FOOD	4.6	2.8
AMOUNT OF FOOD	4.8	3.2
VARIETY BETWEEN MEALS	4.3	3.4
NUTRITIONAL VALUE OF MEALS	4.8	3.7

* 1 = Very Dissatisfied ... 4 = Neutral ... 7 = Very Satisfied

In the 1986 field study (1), similar results were obtained. However, in the 1983 study (2), satisfaction with flavor, appearance and variety was greater than in the present study, but there was less satisfaction with the amount of food in the MRE in 1983 than in the present test. Because the 1983 study was a longer test and there was no alternative food choice, subjects may have rationalized that since they ate the MRE for 34 days, they must have been satisfied with it. Similarly, subjects in the 1983 study may have been somewhat more dissatisfied with the amount of food in the ration because the MRE was their sole source of food for such a long period of time.

Subjects were asked to rate how often they heated the MRE entree. The scale ranged from 1 (never) to 6 (always). Eighty-seven percent of subjects said they never heated the MRE. Dissatisfaction and limited intake of the MRE may have been a consequence of having to eat the MRE entrees cold. Although some subjects may have not wanted to eat hot food because of the hot weather, it appears that most individuals prefer to eat foods at normal serving temperatures. Appropriate serving temperature is important to acceptance (16).

Satisfaction with the variety of each food group was rated for the B Ration and the MRE. Variety was rated on a 4-point scale, where 1 corresponds to "variety now enough," and 4 corresponds to "should be much more variety." Mean ratings of variety for the B Ration and MRE can be found in Table 16. Similar ratings of variety for the MRE were obtained in the previous field studies (1, 2). Table 16 also includes the

percentages of subjects who felt that the rations contained enough variety.

TABLE 16.

Ratings of Variety, B Ration and MRE. *

<u>FOOD GROUP</u>	<u>B RATION</u> (mean)	<u>ENOUGH VARIETY</u> (% - B Ration)	<u>MRE</u> (mean)	<u>ENOUGH VARIETY</u> (% - MRE)
DINNER ENTREES	2.3	26	2.5	19
STARCHES	2.3	23	2.8	15
DESSERTS	2.1	37	2.5	26
FRUITS	2.5	21	2.7	20
VEGETABLES	2.4	23		
(B Ration only)				
SPREADS	2.2	34	2.5	24
DRINKS	2.4	25	2.8	22
CONDIMENTS	2.0	43	2.4	39

* 1 = Variety Now Enough ... 4 = Should Be Much More Variety

When asked which food items they would like added to the B Ration, condiments were listed by 36% of subjects. The ones mentioned the most were catsup (14%) and butter (9%). Mustard, Tabasco^(R) sauce, steak sauce, gravy and spices were also mentioned. Catsup, mustard and various spices are already included in the B Ration; they may not have been available during the present evaluation. Drinks, particularly cold drinks, such as soft drinks, Gatorade^(R) and milk were popular requests. Spaghetti, candy bars and more fruit were also mentioned.

When asked what they would like added to the ration when it was to be eaten in hot environments, 14% of subjects mentioned that they would like to have more of a variety of drinks, especially cold drinks such as soft drinks, flavored drinks, iced tea, cold water and Gatorade^(R). They would also like to have

ice. A number of subjects suggested having cold sandwiches rather than hot meals at dinnertime.

When asked which B Ration items they would like dropped, milk was listed by 13 subjects (eight who had tried the milk during the evaluation period, five who had not). If the milk were dropped, the calcium content of the ration would be greatly reduced. A number of subjects also mentioned that eggs, hash browns, grilled meat and succotash should be dropped. Particularly in hot environments, milk was again mentioned as an item which should be dropped from the menu. As was noted previously, a large number of subjects did not even taste the milk. Subjects also did not indicate which flavor milk they felt should be deleted from the ration; it is not clear whether they were referring to the plain, chocolate or strawberry milk, or milk in general. Since the warm, nonfat reconstituted milk is clearly not acceptable, its recipe should be reformulated. Otherwise, additional sources of calcium need to be considered.

The final questionnaire also addressed subjects' general opinions and preferences related to eating in a hot environment. Subjects either agreed or disagreed with several statements using a 7-point scale, where 1 corresponds to "disagree extremely," 4 corresponds to "neither agree nor disagree," and 7 corresponds to "agree extremely." In response to a statement about preference for eating more salty foods in hot versus cold weather, subjects stated a very slight preference for liking more salty foods in a hot versus a cold environment ($\bar{x} = 4.4$, $SD = 1.6$). Subjects agreed that they drink more beverages when the weather is hot

than when it is cold ($\bar{x} = 6.3$, $SD = 1.4$). There was generally slight agreement with the statements "I like to eat less when the weather is hot than when it is cool." and "I like to eat more cold foods when the weather is hot than when it is cool." ($\bar{x} = 5.2$, $SD = 1.7$; $\bar{x} = 4.8$, $SD = 1.7$, respectively). Most subjects did not like to eat spicier foods during hot weather than during cold weather ($\bar{x} = 3.2$, $SD = 1.5$).

Subjects were asked to list any foods or beverages they consumed more or less of during the week of the study because of the heat. Ninety-two percent of subjects said they drank more beverages during the week; 83% drank more water, 43% drank more soft drinks (which were obtained from vending machines), and 9% drank more of other beverages such as fruit-flavored drinks. Subjects reported that they drank less milk and hot beverages during the week and ate less meat and less food in general. Because they were asked to restrict their diet to the B Ration and MRE items, those that abided by the restrictions also drank less soda and ate fewer fresh foods than usual.

When asked to comment on the MRE overall, about one quarter of the subjects said they didn't like them. A number of subjects mentioned that although the ration was adequate for its purpose, it needed improvement, e.g., more variety, better taste, and larger portions. These changes have been implemented in the newly developed MRE VIII. Other subjects mentioned that the dehydrated items would taste much better if hot water were available to add to them.

About 12% commented positively about the B Ration, saying that it was better than expected or it tasted good. A number of subjects felt it generally needed improvement; some specific improvements included making the breakfast better and improving the quality of certain items, in particular, the milk and the eggs. Others commented that the day-to-day cooking was variable; some days it was good, and other days it was poor. In fact, meals were not prepared by the same cooks each day. Additional suggestions included adding more drinks and fruit to the ration, and decreasing the amount of hot food served in hot environments.

CONCLUSIONS AND RECOMMENDATIONS

The results of the present study suggest that the airmen's consumption of the B Ration and MRE in an extremely hot environment does not meet military requirements. Intake of the majority of vitamins, minerals and macronutrients was below the MRDA because average energy intake was only 2200 kilocalories. The low intake of vitamin A and calcium is of particular concern. Serving more vegetables containing large amounts of vitamin A such as broccoli, carrots and spinach is recommended. The low calcium intake is largely the result of dissatisfaction with the milk and cottage cheese. Additional foods rich in calcium need to be added to the B Ration. One possibility that would help to increase calcium intake would be to formulate a recipe for cheese pizza as part of the B Ration. Since pizza was a nonration item

reportedly consumed by airmen during the study, it would probably be a welcome addition to the ration. Another possibility would be to substitute T Ration lasagna for one of the regular B Ration entrees. An alternate solution would be to fortify B Ration foods with calcium. Presently, the hot cocoa is fortified with calcium; however, this would not be an item that would be served in hot environments.

Eglin Air Force Base cannot be considered a typical field site because of the wide availability of nonration foods. If the operational ration was the only source of food available, it is possible that ration consumption and nutrient intake would have been higher, especially at the dinner meal. The data show that airmen at Eglin ate a considerable amount of nonration foods. Studies should be done in more isolated sites to determine actual consumption of the B Ration in a field environment.

Even though there were nonration foods available, the B Ration was well accepted, with the exception of the dairy products and some of the breakfast foods. Given that the cholesterol intake was high at breakfast and the acceptability of the eggs was low, it is recommended that eggs be served less frequently. An egg substitute could also be used in recipes to reduce the intake of cholesterol.

There was no evidence from the results of this study that adding flavorants to the currently available dehydrated milk increased its acceptability or enhanced consumption at warm temperatures. The extremely low acceptability ratings of the milk reported in this evaluation suggest a need to reformulate

this B Ration item. In fact, there is currently (FY88) a project being conducted by the Food Engineering Directorate at Natick to reformulate the dehydrated milk base.

Acceptability and satisfaction ratings of the MRE were significantly lower than ratings of the B Ration. Problems with the MRE mentioned by airmen in the present study have been addressed by food developers. The most recent procurement of the MRE (MRE VIII) includes larger entree portion sizes, new and reformulated entrees, fruit-flavored beverage powders, commercial candy, and hot sauce. The dehydrated meat patties received very low ratings in the present evaluation and these have been removed from MRE VIII. These improvements have increased the acceptance and consumption of the MRE (1).

Recommendations for improving the B Ration, particularly when the ration is to be consumed in hot environments, include increasing the variety of beverages, serving cold sandwiches at dinner rather than hot meals, and adding more condiments to the ration. Menu modifications are also suggested to improve calcium and vitamin A intake. Since refrigeration is not available, it is especially important that beverages be served which are acceptable when served at room temperature.

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APPENDICES

- A. Background Information Form
- B. Volunteer Agreement Form
- C. B Ration Menus: Breakfast and Dinner, Days 1-5
- D. Acceptability Form, B Ration
- E. Consumption/Acceptability Form, MRE
- F. Intake Record, B Ration
- G. Final Questionnaire
- H. Weather Data: Temperatures and Relative Humidity during the Field Test

APPENDIX A. BACKGROUND INFORMATION FORM

Background Information

Please provide the following information. This information will be linked to food preferences, and will be used to help evaluate the combat ration. All information is confidential. Your name will not be used in any report of this test.

1. Name: _____
2. Sex: Male _____ Female _____
3. Rank: _____
4. AFESC: _____
5. Age: _____ years _____ months
6. Height: _____ Weight: _____
7. Are you trying to lose weight? Yes _____ No _____
8. Are you trying to gain weight? Yes _____ No _____
9. How long have you been in the Air Force? _____ years _____ months
10. Home base _____ City _____ State _____
11. Please list other HOT WEATHER field experiences you have had:

	I	II	III	IV
Location: _____	_____	_____	_____	_____
Year: _____	_____	_____	_____	_____
Duration: _____	_____	_____	_____	_____
Temperature: _____	_____	_____	_____	_____
Weather: _____	_____	_____	_____	_____
Ration served: _____	_____	_____	_____	_____

12. How would you describe the climate in the area that you lived in for the longest period of time in your life?

- a. hot climate (for example, Texas, Florida, Arizona)
- b. cold climate (for example, Minnesota, Alaska, Vermont)
- c. mixed climate (hot summers, cold winters; for example, Massachusetts, Ohio, Iowa)
- d. temperate climate (mild weather; for example, North Carolina, Hawaii, Northern California)

13. On what TYPES OF COOKING were you raised? Circle three or less.

- | | |
|---------------------------|---------------------------------|
| a. Chinese | j. Jewish |
| b. English | k. Mexican |
| c. French | l. New England |
| d. General American Style | m. Polish/Eastern European |
| e. German | n. Soul |
| f. Greek/Middle Eastern | o. Southern |
| g. Indian/Southeast Asian | p. Spanish (not Mexican) |
| h. Italian | q. Other (please specify _____) |
| i. Japanese | |

APPENDIX B. VOLUNTEER AGREEMENT FORM

VOLUNTEER AGREEMENT AFFIDAVIT

For use of this form, see AR 40-38; the proponent agency is the Office of the Surgeon General

THIS FORM IS AFFECTED BY THE PRIVACY ACT OF 1974**1. AUTHORITY:** 10 USC 8012, 44 USC 8101 and 10 USC 1073-1087.**2. PRINCIPAL PURPOSE:** To document voluntary participation in the Clinical Investigation and Research Program. SSN and home address will be used for identification and locating purposes.**3. ROUTINE USES:** The SSN and home address will be used for identification and locating purposes. Information derived from the study will be used to document the study; implementation of medical programs; teaching; adjudication of claims; and for the mandatory reporting of medical condition as required by law. Information may be furnished to Federal, State and local agencies.**4. MANDATORY OR VOLUNTARY DISCLOSURE:** The furnishing of SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this investigational study.**PART A - VOLUNTEER AFFIDAVIT****VOLUNTEER SUBJECTS IN APPROVED DEPARTMENT OF THE ARMY RESEARCH STUDIES**

Volunteers under the provisions of AR 70-25 are authorized all necessary medical care for injury or disease which is the proximate result of their participation in such studies.

I, _____ SSN _____ having
(last, first, middle)

full capacity to consent and having attained my _____ birthday, do hereby volunteer to participate in

B Ration Menu and Water Treatments to Encourage Consumption in Extreme Hot and
Cold Environments.
(research study)under direction of Dr. Dianne Engell conducted at Eglin Air Force Base, Florida
(name of institution)The implications of my voluntary participation; the nature, duration and purpose of the research study; the methods and means by which it is to be conducted; and the inconveniences and hazards that may reasonably be expected have been explained to me by Dr. Dianne Engell,I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights on study-related injury I may contact
Office of the Chief Counselat Natick Research, Development and Engineering Center, (617) 651-4322
(name and address of hospital & phone number (include area code))I understand that I may at any time during the course of this study revoke my consent and withdraw from the study without further penalty or loss of benefits however, I may be ☒ required (military volunteer) or ☐ requested (civilian volunteer) to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my health and well-being. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled.**PART B - TO BE COMPLETED BY INVESTIGATOR****INSTRUCTIONS FOR ELEMENTS OF INFORMED CONSENT:** (Provide a detailed explanation in accordance with Appendix E, AR 40-38 or AR 70-25.)

See other side

VOLUNTEER'S EXPLANATION

The purpose of this study is to evaluate the acceptability of B-ration in a hot environment.

The study will take place at breakfast, lunch, and dinner for 5 days. If you agree to participate you will be asked to complete a short questionnaire with each meal for the 5 day period. This questionnaire will ask you to rate how much you liked the meal items. At lunchtime you will also complete a questionnaire to estimate how much you eat and drink. At breakfast and dinner, technicians will observe how much you eat and drink. Meals during the study will consist of hot B-ration items for breakfast and dinner and MRE's for lunch.

There are no direct benefits to participants, however the information collected is very important for the Air Force's evaluation of B-ration consumption in a hot environment. There are no risks associated with participation in this study.

If you have any questions about this study, feel free to ask or discuss them with the investigators at any time. If you wish to discuss the results of the study, you may do so but not until your participation is complete. If you volunteer for this study, we would like to be reasonably certain that you will complete it. But you have the right to withdraw from this study at any time without adverse consequences or prejudice.

All data and information obtained about you as an individual will be considered privileged and held in confidence. Complete confidentiality cannot be promised, particularly to subjects who are military members, because information bearing on your health may be required to be reported to appropriate medical or Command authorities, and applicable regulations note the possibility that the Food and Drug Administration and USAMRDC officials may inspect the records.

SIGNATURE OF VOLUNTEER	DATE SIGNED	SIGNATURE OF LEGAL GUARDIAN (If volunteer is a minor)	
PERMANENT ADDRESS OF VOLUNTEER	TYPE OR PRINT NAME AND SIGNATURE OF WITNESS		DATE SIGNED

APPENDIX C. B RATION MENUS: BREAKFAST AND DINNER, DAYS 1-5

DAY 1

BREAKFAST

Grilled meat
Bacon
Scrambled eggs
Hash brown potatoes
Biscuits
Grits
Pancakes
French toast
Syrup
Jam/jelly
Peanut butter
Coffee cake
Bread
Coffee
Grape juice
Orange juice
Apple juice
Milk, plain

DINNER

*Beef w/BBQ sauce
Fried fish
Macaroni w/cheese
Peas
Corn
Cottage cheese
Peaches
White bread
Jam/jelly
Peanut butter
Brownies
White cake
Coffee
Cherry beverage

*T Ration item

DAY 2

BREAKFAST

Grilled meat
Bacon
Creamed beef
Scrambled eggs
Hash brown potatoes
Biscuits
Grits
Pancakes
French toast
Syrup
Jam/jelly
Peanut butter
Coffee cake
White bread
Coffee
Grape juice
Apple juice
Pineapple juice
Milk, chocolate

DINNER

Creole chicken w/sauce
*Roast beef w/gravy
Rice
Carrots and Peas
Succotash
Fruit cocktail
Jam/jelly
Peanut butter
White bread
White cake
Chocolate pudding
Coffee
Grape beverage

*T Ration item

DAY 3

BREAKFAST

Grilled meat
Bacon
Creamed beef
Scrambled eggs
Hash brown potatoes
Biscuits
Grits
Pancakes
French toast
Syrup
Jam/jelly
Peanut butter
Coffee cake
White bread
Coffee
Grape juice
Orange juice
Pineapple juice
Milk, plain
Milk, chocolate
Milk, strawberry

DINNER

Creole shrimp w/sauce
*Pepper steak w/sauce
Rice
*Peas w/mushrooms
Green beans
Cottage cheese
Pineapple
Jam/jelly
Peanut butter
Brownies
Oatmeal cookies
White bread
Coffee
Grape beverage
Cherry beverage
Lemonade

*T Ration items

DAY 4

BREAKFAST

Grilled meat
Bacon
Creamed beef
Scrambled eggs
Hash brown potatoes
Biscuits
Grits
Pancakes
French toast
Syrup
Jam/jelly
Peanut butter
Coffee cake
White bread
Coffee
Grape juice
Orange juice
Pineapple juice
Milk, strawberry

DINNER

Beefsteak w/gravy
*Turkey slices w/gravy
Mashed potatoes
Corn
*Mixed vegetables
Cornbread
White cake
White bread
Jam/jelly
Peanut butter
Hot coffee
Lemonade
Fruit cocktail

*T Ration items

DAY 5

BREAKFAST

Bacon

Scrambled eggs

Hash brown potatoes

Biscuits

Grits

French toast

Syrup

Jam/jelly

Peanut butter

Coffee cake

White bread

Coffee

Milk, plain

Milk, chocolate

Milk, strawberry

APPENDIX D. ACCEPTABILITY FORM, B RATION

DATE: Thur, 20 Aug

NAME _____

NUMBER _____

BREAKFAST RATINGS

Circle the number that indicates how much you liked or disliked the foods and beverages that you consumed at this meal. If you did not eat or drink an item circle the 0. If an item is not listed write it in at the end.

CODE	FOOD ITEM	DID NOT TRY	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE/ DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
206	Grilled meat	0	1	2	3	4	5	6	7	8	9
207	Bacon	0	1	2	3	4	5	6	7	8	9
208	Creamed beef	0	1	2	3	4	5	6	7	8	9
209	Scrambled eggs	0	1	2	3	4	5	6	7	8	9
407	Hash brown potatoes	0	1	2	3	4	5	6	7	8	9
408	Biscuits	0	1	2	3	4	5	6	7	8	9
409	Grits	0	1	2	3	4	5	6	7	8	9
210	Pancakes	0	1	2	3	4	5	6	7	8	9
211	French toast	0	1	2	3	4	5	6	7	8	9
304	Syrup	0	1	2	3	4	5	6	7	8	9
301	Jam/jelly	0	1	2	3	4	5	6	7	8	9
303	Peanut butter	0	1	2	3	4	5	6	7	8	9
410	Coffee cake	0	1	2	3	4	5	6	7	8	9
411	Bread	0	1	2	3	4	5	6	7	8	9
701	Coffee	0	1	2	3	4	5	6	7	8	9
705	Grapefruit juice	0	1	2	3	4	5	6	7	8	9
709	Orange juice	0	1	2	3	4	5	6	7	8	9
710	Tomato juice	0	1	2	3	4	5	6	7	8	9
703	Milk, chocolate	0	1	2	3	4	5	6	7	8	9
Other	_____	0	1	2	3	4	5	6	7	8	9
Other	_____	0	1	2	3	4	5	6	7	8	9

BETWEEN MEALS

If you ate or drank anything between yesterday's evening meal and this morning's breakfast, please list the item(s), circle the amount consumed, and write in the approximate time you ate the item (for example 2200, 0700). See example

ITEM & SIZE	AMOUNT CONSUMED	TIME CONSUMED
Example: <u>can of coke</u>	1/4 1/2 <u>3/4</u> ALL	<u>1930</u>
_____	1/4 1/2 3/4 ALL	_____
_____	1/4 1/2 3/4 ALL	_____
_____	1/4 1/2 3/4 ALL	_____
_____	1/4 1/2 3/4 ALL	_____
_____	1/4 1/2 3/4 ALL	_____

APPENDIX E. CONSUMPTION/ACCEPTABILITY FORM, MRE

Day _____ Name _____ SSN _____ Code _____ MRE _____

RATION CONSUMPTION

Circle the number that indicates how much of each item you ate today. If you ate an amount that is not listed, write it on the line to the right.

ADDED WATER

How many cups of water (Roz.) (1/4, 1/2, 3/4, 1, etc) did you add to each item you ate or drank. Write "0" if you didn't add water to an item you had.

RATING OF FOOD

Please circle the numbers that indicate how much you liked or disliked the ration items that you ate today.

FOOD ITEM	CODE	AMOUNT CONSUMED						WATER	RATING OF FOOD								
		0	1/4	1/2	3/4	ALL			DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE/DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
CENTREES																	
Pork Patties	6	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Ham/Chicken Loaf	7	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Beef Patties	8	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Beef W/BBQ Sauce	9	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Beef Stew	10	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Frankfurters	11	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Diced Turkey W/Gravy	12	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Diced Beef W/Gravy	13	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Chicken a la King	14	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Meatballs W/BBQ Sauce	15	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Ham Slices	16	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Ground Beef W/Spiced Sauce	17	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
FRUITS																	
Applesauce	22	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Fruit Mix	25	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Peaches	24	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Strawberries	23	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
DESSERTS																	
Brownie	29	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Cherry Nut Cake	30	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Choc Covered Cookie	27	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Fruitcake	32	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Maple Nut Cake	31	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Orange Nut Cake	34	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Chocolate Nut Cake	33	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Pineapple Nut Cake	28	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
STARCHES																	
Crackers	26	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Beans W/Tomato Sauce	18	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Potato Patty	21	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
SPREADS																	
Cheese Spread	43	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Jelly	44	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Peanut Butter	47	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
BEVERAGES																	
Cocoa	1	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Coffee	2	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
OTHER																	
Ketchup	45	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Cream Substitute	3	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Soup/Grey Base	46	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Sugar	134	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Salt	136	0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9
Gum	42	_____	pieces				_____	N/A	1	2	3	4	5	6	7	8	9
Candy (What Kind?)		0	1/4	1/2	3/4	ALL	_____	N/A	1	2	3	4	5	6	7	8	9

NATICK Form 692 (ONE-TIME)

1 Aug 87

PLEASE TURN THE PAGE

LUNCH

1) If there was something in the MRE you ate or drank that was not listed on the front, or there was no room to write it in (for instance, if you ate a second candy bar), please describe the item here.

ITEM	AMOUNT CONSUMED	WATER ADDED (cups, 8 oz)
_____	0 1/4 1/2 3/4 ALL _____	_____
_____	0 1/4 1/2 3/4 ALL _____	_____

2) How much time did it take you to prepare and eat your MRE today?
_____ (minutes)

3) When did you eat your MRE? a) all at one time OR b) throughout the day
(circle one)

4) With how many people did you sit while you ate your MRE? _____

5) With how many people did you talk while you ate your MRE? _____

6) How easy was it for you to get water for the MRE?

extremely easy	moderately easy	somewhat easy	neither easy nor difficult	somewhat difficult	moderately difficult	extremely difficult
1	2	3	4	5	6	7

BETWEEN MEALS

7) If you ate or drank something between meals, please list the item(s) and circle the amount consumed (see examples). If you ate an amount that is not listed, write it on the line to the right.

TIME PERIOD	ITEM & SIZE	AMOUNT CONSUMED
<u>between breakfast and lunch</u>	<u>pint of orange juice</u>	0 1/4 <u>1/2</u> 3/4 ALL _____
	_____	0 1/4 1/2 3/4 ALL _____
	_____	0 1/4 1/2 3/4 ALL _____
	_____	0 1/4 1/2 3/4 ALL _____
<u>between lunch and the evening meal</u>	<u>package MRE crackers</u>	0 1/4 1/2 3/4 <u>ALL</u> _____
	_____	0 1/4 1/2 3/4 ALL _____
	_____	0 1/4 1/2 3/4 ALL _____
	_____	0 1/4 1/2 3/4 ALL _____

APPENDIX F. INTAKE RECORD, B RATION

RATION INTAKE RECORD

DATE: Sat, 22 Aug

SUBJECT NAME _____

DATA COLLECTOR _____

SUBJECT # _____

DATA ENTERER _____

DINNER

CODE	FOOD ITEM	PORTION SERVED	PORTION REMAINING
204	Beefsteak w/gravy	_____	_____
805	Turkey slices w/gravy	_____	_____
404	Mashed potatoes	_____	_____
502	Corn	_____	_____
806	Mixed vegetables	_____	_____
405	Cornbread	_____	_____
602	White cake	_____	_____
402	White bread	_____	_____
301	Jam, jelly	_____	_____
303	Peanut butter	_____	_____
701	Hot coffee	_____	_____
708	Lemonade	_____	_____
505	Fruit cocktail	_____	_____
Other	_____	_____	_____
Other	_____	_____	_____

KEY

1/20 = .05
1/10 = .10
1/8 = .125
1/4 = .25
3/8 = .375
1/2 = .50
5/8 = .625
3/4 = .75
7/8 = .875

APPENDIX G. FINAL QUESTIONNAIRE

NAME _____

B-RATION and MRE V

NUMBER _____

FINAL QUESTIONNAIRE

We would like to ask your opinions about the rations you ate this week. B-rations were served at breakfast and evening meals, and MREs were served at lunch. Your opinions will be very important in determining any changes that will be made in the rations, so please answer the questions thoughtfully.

1. Overall, did you get enough to eat this week or were you often hungry? Circle one number.

- | | |
|-------------------------|-----------------------------|
| 1. Got enough to eat | 3. Was often hungry |
| 2. Was sometimes hungry | 4. Was almost always hungry |

2. Overall, did you get enough to drink this week or were you often thirsty?

- | | |
|--------------------------|------------------------------|
| 1. Got enough to drink | 3. Was often thirsty |
| 2. Was sometimes thirsty | 4. Was almost always thirsty |

3. Please rate how SATISFIED or DISSATISFIED you were with each of the following aspects of the B-rations and MREs you ate this week. Circle one number for each aspect.

VERY DISSATISFIED	MODERATELY DISSATISFIED	SOMEWHAT DISSATISFIED	NEITHER SATISFIED NOR DISSATISFIED	SOMEWHAT SATISFIED	MODERATELY SATISFIED	VERY SATISFIED
1	2	3	4	5	6	7

	<u>B-RATION</u>	<u>MRE</u>
a. flavor of food	1 2 3 4 5 6 7	1 2 3 4 5 6 7
b. appearance of food	1 2 3 4 5 6 7	1 2 3 4 5 6 7
c. amount of food	1 2 3 4 5 6 7	1 2 3 4 5 6 7
d. variety between meals	1 2 3 4 5 6 7	1 2 3 4 5 6 7
e. nutritional value of meals	1 2 3 4 5 6 7	1 2 3 4 5 6 7

4. We would like to know how satisfied you were with the VARIETY in the rations. Please circle one number for each component of the B-ration and the MRE.

VARIETY
NOW
ENOUGH
1

SHOULD BE
SOMEWHAT MORE
VARIETY
2

SHOULD BE
MODERATELY MORE
VARIETY
3

SHOULD BE
MUCH MORE
VARIETY
4

	<u>B-RATION</u>				<u>MRE</u>			
a. Dinner entrees (for example, creole chicken, ham slices, meatballs w/BBQ sauce)	1	2	3	4	1	2	3	4
b. Starches (rice, crackers, potatoes)	1	2	3	4	1	2	3	4
c. Desserts (cakes, cookies, brownies)	1	2	3	4	1	2	3	4
d. Fruits	1	2	3	4	1	2	3	4
e. Vegetables (B-rations only)	1	2	3	4				
f. Spreads (peanut butter, cheese, jelly)	1	2	3	4	1	2	3	4
g. Drinks	1	2	3	4	1	2	3	4
h. Condiments (salt, catsup, gravy base)	1	2	3	4	1	2	3	4

5. We would like to know what you think of the amount of food provided in a single meal. Were the PORTIONS too small, too large, or just right? Please circle one number for each component of the B-ration and the MRE.

PORTION
MUCH TOO
SMALL
1

PORTION
MODERATELY
TOO SMALL
2

PORTION
SOMEWHAT
TOO SMALL
3

PORTION
JUST RIGHT
4

PORTION
SOMEWHAT
TOO LARGE
5

PORTION
MODERATELY
TOO LARGE
6

PORTION
MUCH TOO
LARGE
7

	<u>B-RATION</u>							<u>MRE</u>						
a. Dinner entrees (for example, creole chicken ham slices, meatballs w/BBQ sauce)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
b. Starches (rice, crackers, potatoes)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
c. Desserts (cakes, cookies, brownies)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
d. Fruits	1	2	3	4	5	6	7	1	2	3	4	5	6	7
e. Vegetables (B-rations only)	1	2	3	4	5	6	7							
f. Spreads (cheese, peanut butter, jelly)	1	2	3	4	5	6	7	1	2	3	4	5	6	7

6. We would like your honest evaluation of the B-RATION items you ate for the breakfast and evening meals this week. Using the scale below, please circle one number for each item that best expresses your opinion of that item.

NEVER TRIED 0	DISLIKE EXTREMELY 1	DISLIKE VERY MUCH 2	DISLIKE MODERATELY 3	DISLIKE SLIGHTLY 4	NEITHER LIKE NOR DISLIKE 5	LIKE SLIGHTLY 6	LIKE MODERATELY 7	LIKE VERY MUCH 8	LIKE EXTREMELY 9
206. Grilled meat (breakfast)	0				1 2 3 4 5 6 7 8 9				
207. Bacon	0				1 2 3 4 5 6 7 8 9				
208. Creamed beef	0				1 2 3 4 5 6 7 8 9				
209. Scrambled eggs	0				1 2 3 4 5 6 7 8 9				
210. Pancakes	0				1 2 3 4 5 6 7 8 9				
211. French toast	0				1 2 3 4 5 6 7 8 9				
201. Fried fish	0				1 2 3 4 5 6 7 8 9				
202. Creole chicken	0				1 2 3 4 5 6 7 8 9				
203. Creole shrimp	0				1 2 3 4 5 6 7 8 9				
204. Beefsteak w/gravy	0				1 2 3 4 5 6 7 8 9				
205. Beef patties jardiniere	0				1 2 3 4 5 6 7 8 9				
801. Beef w/BBQ sauce	0				1 2 3 4 5 6 7 8 9				
802. Roast beef w/mushroom gravy	0				1 2 3 4 5 6 7 8 9				
803. Pepper steak	0				1 2 3 4 5 6 7 8 9				
807. Lasagna	0				1 2 3 4 5 6 7 8 9				
805. Turkey slices w/gravy	0				1 2 3 4 5 6 7 8 9				
407. Hash brown potatoes	0				1 2 3 4 5 6 7 8 9				
408. Biscuits	0				1 2 3 4 5 6 7 8 9				
409. Grits	0				1 2 3 4 5 6 7 8 9				
410. Coffee cake	0				1 2 3 4 5 6 7 8 9				
411. White bread	0				1 2 3 4 5 6 7 8 9				
401. Macaroni w/cheese	0				1 2 3 4 5 6 7 8 9				
403. Rice	0				1 2 3 4 5 6 7 8 9				
404. Mashed potatoes	0				1 2 3 4 5 6 7 8 9				
405. Cornbread	0				1 2 3 4 5 6 7 8 9				
304. Syrup	0				1 2 3 4 5 6 7 8 9				
301. Jam, jelly	0				1 2 3 4 5 6 7 8 9				
303. Peanut butter	0				1 2 3 4 5 6 7 8 9				
501. Peas	0				1 2 3 4 5 6 7 8 9				
502. Corn	0				1 2 3 4 5 6 7 8 9				
509. Cottage cheese	0				1 2 3 4 5 6 7 8 9				
508. Peaches	0				1 2 3 4 5 6 7 8 9				
503. Carrots and peas	0				1 2 3 4 5 6 7 8 9				
504. Succotash	0				1 2 3 4 5 6 7 8 9				
505. Fruit cocktail salad	0				1 2 3 4 5 6 7 8 9				

NEVER TRIED 0	DISLIKE EXTREMELY 1	DISLIKE VERY MUCH 2	DISLIKE MODERATELY 3	DISLIKE SLIGHTLY 4	NEITHER LIKE NOR DISLIKE 5	LIKE SLIGHTLY 6	LIKE MODERATELY 7	LIKE VERY MUCH 8	LIKE EXTREMELY 9
---------------------	---------------------------	------------------------------	----------------------------	--------------------------	-------------------------------------	-----------------------	-------------------------	---------------------------	------------------------

506. Green beans	0	1	2	3	4	5	6	7	8	9
507. Pineapple	0	1	2	3	4	5	6	7	8	9
806. Mixed vegetables	0	1	2	3	4	5	6	7	8	9
804. Peas w/mushrooms	0	1	2	3	4	5	6	7	8	9
601. Chocolate brownies	0	1	2	3	4	5	6	7	8	9

602. White cake	0	1	2	3	4	5	6	7	8	9
603. Yellow cake	0	1	2	3	4	5	6	7	8	9
604. Chocolate pudding	0	1	2	3	4	5	6	7	8	9
605. Oatmeal cookies	0	1	2	3	4	5	6	7	8	9
606. Cherry crunch	0	1	2	3	4	5	6	7	8	9

701. Coffee	0	1	2	3	4	5	6	7	8	9
705. Grapefruit juice	0	1	2	3	4	5	6	7	8	9
709. Orange juice	0	1	2	3	4	5	6	7	8	9
710. Tomato juice	0	1	2	3	4	5	6	7	8	9
702. Milk, plain	0	1	2	3	4	5	6	7	8	9

703. Milk, chocolate	0	1	2	3	4	5	6	7	8	9
704. Milk, strawberry	0	1	2	3	4	5	6	7	8	9
706. Cherry beverage	0	1	2	3	4	5	6	7	8	9
707. Grape beverage	0	1	2	3	4	5	6	7	8	9
708. Lemonade	0	1	2	3	4	5	6	7	8	9

7. Are there any foods, drinks, spices, or sauces that you would like ADDED to the B-RATIONS in general, and are there any items that you would like added to the B-RATIONS especially when you are in a hot environment?

<u>IN GENERAL</u>	<u>HOT ENVIRONMENT ONLY</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

8. Are there any foods, drinks, spices, or sauces that you would like DROPPED from the B-RATIONS in general, and are there any items that you would like dropped from the B-RATIONS especially when you are in a hot environment?

<u>IN GENERAL</u>	<u>HOT ENVIRONMENT ONLY</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

9. We would like your honest evaluation of the MRE items you ate for lunch this week. Using the scale below, please circle one number for each item that best expresses your opinion of that item.

NEVER TRIED 0	DISLIKE EXTREMELY 1	DISLIKE VERY MUCH 2	DISLIKE MODERATELY 3	DISLIKE SLIGHTLY 4	NEITHER LIKE NOR DISLIKE 5	LIKE SLIGHTLY 6	LIKE MODERATELY 7	LIKE VERY MUCH 8	LIKE EXTREMELY 9
9. Beef w/Barbeque Sauce	0				1 2 3 4 5 6 7 8 9				
13. Beef w/Gravy	0				1 2 3 4 5 6 7 8 9				
17. Beef w/Spiced Sauce	0				1 2 3 4 5 6 7 8 9				
8. Beef Patties	0				1 2 3 4 5 6 7 8 9				
10. Beef Stew	0				1 2 3 4 5 6 7 8 9				
14. Chicken Ala King	0				1 2 3 4 5 6 7 8 9				
11. Frankfurters	0				1 2 3 4 5 6 7 8 9				
7. Ham/Chicken Loaf	0				1 2 3 4 5 6 7 8 9				
16. Ham Slices	0				1 2 3 4 5 6 7 8 9				
15. Meatballs w/Barbeque Sauce	0				1 2 3 4 5 6 7 8 9				
6. Pork Sausage Patties	0				1 2 3 4 5 6 7 8 9				
12. Turkey w/Gravy	0				1 2 3 4 5 6 7 8 9				
26. Crackers	0				1 2 3 4 5 6 7 8 9				
18. Beans w/Tomato Sauce	0				1 2 3 4 5 6 7 8 9				
21. Potato Patty	0				1 2 3 4 5 6 7 8 9				
43. Cheese Spread	0				1 2 3 4 5 6 7 8 9				
44. Jelly	0				1 2 3 4 5 6 7 8 9				
47. Peanut Butter	0				1 2 3 4 5 6 7 8 9				
22. Applesauce	0				1 2 3 4 5 6 7 8 9				
25. Mixed Fruits	0				1 2 3 4 5 6 7 8 9				
24. Peaches	0				1 2 3 4 5 6 7 8 9				
23. Strawberries	0				1 2 3 4 5 6 7 8 9				
29. Brownie	0				1 2 3 4 5 6 7 8 9				
30. Cherry Nut Cake	0				1 2 3 4 5 6 7 8 9				
27. Chocolate-Covered Cookie	0				1 2 3 4 5 6 7 8 9				
32. Fruitcake	0				1 2 3 4 5 6 7 8 9				
31. Maple Nut Cake	0				1 2 3 4 5 6 7 8 9				
34. Orange Nut Cake	0				1 2 3 4 5 6 7 8 9				
33. Chocolate Nut Cake	0				1 2 3 4 5 6 7 8 9				
28. Pineapple Nut Cake	0				1 2 3 4 5 6 7 8 9				
1. Cocoa	0				1 2 3 4 5 6 7 8 9				
2. Coffee	0				1 2 3 4 5 6 7 8 9				
37. Chocolate Fudge	0				1 2 3 4 5 6 7 8 9				
35. Chocolate Covered Coconut	0				1 2 3 4 5 6 7 8 9				
36. Caramel	0				1 2 3 4 5 6 7 8 9				
38. Vanilla Fudge	0				1 2 3 4 5 6 7 8 9				
40. Starch Jelly Bar	0				1 2 3 4 5 6 7 8 9				
39. Chocolate Toffee	0				1 2 3 4 5 6 7 8 9				
41. Chocolate w/Almonds	0				1 2 3 4 5 6 7 8 9				

10. How often did you HEAT THE ENTREE (main dish) in the MRE? Circle one number.

- | | |
|-----------------|------------------|
| 1. Never | 4. Often |
| 2. Almost never | 5. Almost always |
| 3. Sometimes | 6. Always |

11. How often did you mix water into the dry components of your MRE? Please circle one number for each component.

	ALMOST			ALMOST	
NEVER	NEVER	SOMETIMES	OFTEN	ALWAYS	ALWAYS
1	2	3	4	5	6

- | | | | | | | |
|---|---|---|---|---|---|---|
| a. Entree (beef patty,
pork sausage patty) | 1 | 2 | 3 | 4 | 5 | 6 |
| b. Potato patty | 1 | 2 | 3 | 4 | 5 | 6 |
| c. Fruit | 1 | 2 | 3 | 4 | 5 | 6 |

12. Did you use any hot sauce with your MREs? YES NO

13. How would you describe your level of physical activity during this week? (Circle one number.)

1. Heavy daily physical activity
2. Moderate daily physical activity
3. Light daily physical activity
4. Mixed daily activity day-to-day

14. Please list any foods or beverages that you consumed more of this week because of the heat.

15. Please list any foods or beverages that you consumed less of this week because of the heat.

16. Please circle a number after each statment below that expresses how much you agree or disagree with the statement.

DISAGREE EXTREMELY	MODERATELY DISAGREE	SLIGHTLY DISAGREE	NEITHER AGREE NOR DISAGREE	SLIGHTLY AGREE	MODERATELY AGREE	AGREE EXTREMELY
1	2	3	4	5	6	7

a. I like to eat more salty foods when the weather is hot than when it is cool. ____

b. I like to drink more beverages when the weather is hot than when it is cool. ____

c. I like to eat less when the weather is hot than when it is cool. ____

d. I like to eat spicier foods when the weather is hot than when it is cool. ____

e. I like to eat more cold foods when the weather is hot than when it is cool. ____

17. Do you have any other comments on the MRE?

18. Do you have any other comments on the B-RATION?

APPENDIX H. WEATHER DATA: TEMPERATURES AND RELATIVE
HUMIDITY DURING THE FIELD TEST

Average Temperatures ($^{\circ}$ F) at Breakfast, Lunch and Dinner
During the 5-Day Field Test.

<u>DAY</u>	<u>Breakfast</u>	<u>Lunch</u>	<u>Dinner</u>	<u>Overall</u>
1	76.3	87.0	90.3	84.3
2	77.7	89.5	94.0	85.7
3	77.5	93.5	92.5	87.8
4	78.7	89.3	92.7	86.9
5	78.3	NA	NA	NA
Overall	77.7	89.8	92.4	85.9

Average Temperature ($^{\circ}$ F) and Relative Humidity (%) Each Day
During the 5-Day Field Test

<u>DAY</u>	<u>Temperature</u>	<u>High</u>	<u>Low</u>	<u>Relative Humidity</u>	<u>High</u>	<u>Low</u>
1	85.0	93	78	69.9	85	43
2	86.5	95	78	65.1	81	50
3	83.8	91	74	72.3	94	51
4	82.8	89	77	79.8	93	63
5	82.2	93	74	78.8	100	44
Overall	84.1	95	74	73.2	100	43

Average Outside Temperature ($^{\circ}\text{F}$) and Relative Humidity (%)
During the 5-Day Field Test.

<u>TIME OF THE DAY</u>	<u>TEMPERATURE</u>	<u>RELATIVE HUMIDITY</u>
0100	85.8	73.2
0200	85.0	76.2
0300	84.6	74.8
0400	83.8	75.8
0500	81.6	80.2
0600	79.2	81.4
0700	78.4	85.3
0800	78.4	82.4
0900	78.0	83.6
1000	77.0	87.0
1100	76.8	89.0
1200	76.2	88.0
1300	78.6	82.0
1400	82.2	76.4
1500	85.6	67.6
1600	88.8	61.0
1700	90.2	57.0
1800	91.8	56.5
1900	90.8	57.4
2000	89.4	62.0
2100	89.6	63.0
2200	89.8	61.0
2300	88.2	65.6
2400	87.6	68.4